

Aquilegia

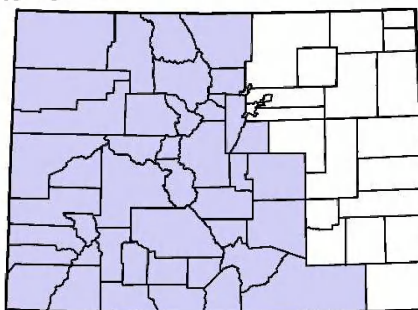
Magazine of the Colorado Native Plant Society

Volume 44 No. 2 Spring 2020





Colorado blue columbine, *Aquilegia coerulea* (Ranunculaceae). The Colorado blue columbine was first collected for science by Edwin James in 1820 and is the state flower of Colorado. This columbine occurs in the Rocky Mountains from Montana to New Mexico and can be found in a variety of moist habitats from the foothills to the alpine. The large, showy flowers consist of five white (rarely blue) petals, which taper to long, nectar-filled spurs, and five sepals. The sepals are generally a shade of blue, but can also range from all white to lavender to a light pink. Var. *daileyae* is all blue-lavender with no spurs. The flowers at lower elevations are usually lighter, possibly indicating a higher reliance on hawk moths for pollination. Other pollinators include bumblebees and hummingbirds. The leaves are biternately compound with deeply cleft, rounded lobes. Seeds are held in elongated bundles of follicles. Columbines hybridize quite readily, so intergrade individuals can be found in places where more than one species occur. *Aquilegia* plants have been used medicinally, but care must be taken as all parts can be toxic. KA



Map adapted from Ackerfield, J. *Flora of Colorado*, p. 707 (2015).

Botanicum absurdum by Rob Pudim



THE CURSE OF NAMING A NEW PLANT

PHOTO CREDITS: Colorado blue columbine, *Aquilegia coerulea*. FRONT COVER © Jen Toews; PAGE 2 © Loveland Pass, Kelly Ambler

Aquilegia uses Jennifer Ackerfield's *Flora of Colorado* (2015) as its preferred guide to plant naming conventions. Readers may also want to familiarize themselves with other guides such as *Colorado Flora*, Eastern and Western editions, by William A. Weber and Ronald C. Wittmann (2012), as well as The Biota of North America Program online guide to North American Vascular Flora (<http://www.bonap.org/>), and other resources.

Aquilegia: Magazine of the Colorado Native Plant Society

Dedicated to furthering the knowledge, appreciation, and conservation of native plants and habitats of Colorado through education, stewardship, and advocacy

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AQUILEGIA: Magazine of the Colorado Native Plant Society
Aquilegia Vol. 44 No.2 Spring 2020
ISSN 2161-7317 (Online) - ISSN 2162-0865 (Print) Copyright CoNPS © 2020
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Managing Editor: Mary Menz, mary.t.menz@gmail.com
Associate/Design Editor: Kelly Ambler, akelly4now@yahoo.com
Assistant Editor: Nan Daniels
Botanical names reviewer: Elizabeth Taylor
Cartoonist: Rob Pudim
Proofreaders: Suzanne Dingwell, Cathi Schramm, Linda Smith, John Vickery

OPERATING COMMITTEE & LEADERSHIP TEAM: Mo Ewing, bayardewing@gmail.com; Ann Grant, odygrant@gmail.com; Irene Weber, iijoweber@gmail.com; Amy Yarger, amy@bigempire.com; **Secretary:** Amy Yarger, amy@bigempire.com; **Treasurer:** Mo Ewing, bayardewing@gmail.com

CHAPTER PRESIDENTS: **Boulder:** Pam Sherman, BoulderCoNPS@gmail.com; **Metro-Denver:** Lenore Mitchell, zap979sar@icloud.com; **Northern:** Ann Grant on behalf of chapter leadership team, odygrant@gmail.com; **Plateau:** Susan Carter, susan.carter@mesacounty.us, Jim Pisarowicz, jim.pisarowicz@gmail.com, David Varner, dvarner3@gmail.com; **Southeast:** Maggie Gaddis, ecocitycoloradosprings@gmail.com; **Southwest:** Anthony Culpepper, anthony@mountainstudies.org, Amanda Kuenzi, amandakuenzi@hotmail.com, Michael Remke, mremke@mountainstudies.org

MEMBERS-AT-LARGE: Christina Alba, christina.alba@botanicgardens.org; Deryn Davidson, ddavidson@bouldercounty.org; Steve Olson, sdolsonoslods@aol.com; Irene Weber, iijoweber@gmail.com; Anna Wilson, annabwilson@gmail.com; Tom Zeiner, tzeiner303@gmail.com

COMMITTEE CHAIRS: **Conservation:** Mo Ewing, bayardewing@gmail.com; **Education & Outreach:** David Julie, bldrjardin@live.com; **Field Studies:** Steve Olson, sdolsonoslods@aol.com, Lara Duran, ld.ecowise@gmail.com; **Finance:** Mo Ewing; **Horticulture:** Ann Grant, odygrant@gmail.com; **Media:** Deryn Davidson, ddavidson@bouldercounty.org, Lenore Mitchell, zap979sar@icloud.com, Steve Olson, sdolsonoslods@aol.com; **Research Grants:** Stephen Stern, stern.r.stephen@gmail.com; **Restoration:** Haley Stratton, hbstratton94@gmail.com; **Scholarships:** Cecily Mui, chmui@hotmail.com

SOCIAL MEDIA: **E-News Editor:** Linda Smith, conpsoffice@gmail.com; **Facebook** Denise Wilson, conpspromote@gmail.com; **Twitter and Instagram:** Jen Bousset, Jennifer.Bousset@colostate.edu and Denise Wilson, conpspromote@gmail.com; **Webmaster:** Mo Ewing, bayardewing@gmail.com

CoNPS STAFF: Linda Smith, administrative coordinator, conpsoffice@gmail.com, 970-663-4085; Denise Wilson, marketing & events coordinator, conpspromote@gmail.com; Kathleen Okon, workshop coordinator, CoNPSworkshops@outlook.com

Featured Story

Celebrating the Bicentennial of Stephen H. Long's Expedition Part 2 of 4: Noteworthy Species Found Along Colorado's Front Range

By Mike Kintgen and Jen Toews

This is the second in a series of four articles about the Long Expedition to the Rocky Mountains.

In the second part of the series on the Long Expedition of 1820, we cover the party's journey from the mouth of the South Platte (present-day Waterton Canyon) to the start of the ascent of Pikes Peak. While this portion of the trip occurred over the span of just 6 days (July 6-11), it was important botanically speaking. During this time, some of the most common foothills native plants were collected and described to science for the first time. Edwin James also encountered Colorado's most famous and beloved native, the Colorado columbine (*Aquilegia coerulea*). Finally, one botanical mystery arose from this portion of the trip that still mystifies botanists to this day.

On July 6, after their ten-day journey along the South Platte through the hot and dry plains of Colorado, the expedition's key players were excited, and perhaps relieved, to reach the chasm of the Platte. The party arrived at its campsite around noon and spent the remainder of the day exploring the picturesque hogbacks of present-day Roxborough State Park. In his writings, James noted the "numerous...columnar rocks, sometimes of snowy whiteness, standing like pyramids and obelisks."

Early the next morning (July 7), James and four other men decided to enter the chasm of the Platte and follow the river as far as they could. It was decided that they would travel via the north side of the river, but due to the water's depth and swiftness one man had to swim across with a rope in his mouth. Once the rope was fastened bank to bank, James and the three other men crossed safely. Due to the steep and rugged terrain, travel was slow and the men only penetrated the canyon to Sheep Mountain, which is located just north of Highway 96, where the North Fork South Platte River meets the South Platte River. It was on Sheep Mountain where James collected many of his specimens including the following three plants, which were described to science for the first time.

***Acer glabrum* Torr. (Rocky Mountain maple)**

On the forested hills of Sheep Mountain, James encountered "a small undescribed acer." This species turned out to be the widespread maple of the western



Acer glabrum (Rocky Mountain maple). © New York Botanical Garden

United States, *Acer glabrum*. James saw this species again on July 10 near present-day Elephant Rock.

***Physocarpus monogynus* (Torr.) J.M. Coulter (mountain ninebark)**

While botanizing the ravines and hillsides of Sheep Mountain, James also collected a specimen of a shrub with attractive palmate leaves and showy clusters of white flowers with exerted stamens. He referred to the plant as *Spiraea opulifolia*, a species that does not naturally occur in Colorado. Torrey would later describe this species under the name *Spiraea monogyna*, and today the accepted name is *Physocarpus monogynus*. See the next page for a photo. ►

◄ ***Rubus deliciosus* Torr. (boulder or “delicious” raspberry)**

Also on Sheep Mountain, James collected a *Rubus* that either would have been *R. deliciosus* or *R. idaeus* ssp. *strigosus*. Because James described the fruit as “highly and pleasingly flavored,” authors Goodman and Lawson argue that the species collected was more likely *Rubus idaeus* ssp. *strigosus*. However, on the type specimen (which resides at New York Botanic Gardens) of *R. deliciosus* are James’s notes: “Fruit large and delicious.” Asa Gray provided an explanation: “in his hurried rush for the mountains, in the too restricted time allowed him by Major Long, [James] was so nearly starved that any edible fruit must have been to him delicious.”

It is interesting to note that while exploring Sheep Mountain, the party reached an elevation of nearly 7,000 feet, which is higher than any point east of the Mississippi. James wrote in his journal that they were nearing the elevation limit of phanogamous vegetation and that flowering plants occurred no higher than 8,000 or 9,000 feet. James would be in for a surprise several days later on his ascent of Pikes Peak. Despite two of the riflemen getting sick, presumed at that time to be from eating too many wild currants, everyone arrived safely back in camp that night.

While breaking camp the morning of July 8, James noted that he had lost his vasculum containing the previous day’s plant collections. He returned to retrieve it and by 7 a.m. the party was on the move again. There is some discrepancy in the journals of James and the others as to the exact route they took after leaving the chasm of the Platte. Piecing it together, Goodman and Lawson have determined the expedition party either traveled between the two hogbacks through present-day Roxborough Park or traveled just east of the hogback. On the evening of July 8, the party camped about 10 miles south of present-day Sedalia.

July 9 was a Sunday and the party stayed in camp. Long climbed present-day Dawson Butte and spotted “Captain Pike’s High Peak.” Interestingly, there is no mention of Mount Evans, Longs Peak, or any of the other iconic high peaks of the Front Range.

***Aquilegia coerulea* E. James (Colorado Blue Columbine)**

On July 10 at midday, the party reached present-day Palmer Lake and noted that when the lake was full it drained into both the Platte and Arkansas River drainages. A highlight was that James encountered one of Colorado’s most charismatic plants and what would arguably become his most famous botanical specimen, *Aquilegia coerulea*. “If it should appear not to have been described,” James wrote, “it may ►



Physocarpus monogynus (Torr.) J.M. Coult (mountain ninebark). © Jen Toews



Rubus deliciosus Torr. (boulder raspberry). © Jen Toews

◀ receive the name of *Aquilegia caerulea*” (Williams, 2003). Based on habitat descriptions in James’s diary, the type specimen was likely collected near the base of Elephant Rock. Seventy-nine years later, Colorado columbine became the state flower of Colorado.

As the Long Expedition continued through the Front Range, James likely collected the type specimens of several other species, although location details are lacking. A number of these taxa are common and widespread natives of the western United States including *Eriogonum umbellata* Torr. (sulphur-flower buckwheat), *Sedum lanceolatum* Torr. (spearleaf stonecrop), and *Pseudostellaria jamesiana* (Torr.) W.A. Weber & R.L. Hartm. (tuber starwort). Another species likely collected during this portion of the journey was a cliff-dwelling species that is endemic to the Southern Rockies, *Heuchera bracteata* (Torr.) Ser.

(Rocky Mountain alumroot). It was described by Torrey under the name *Tiarella bracteata*. Type collections were also made of *Veronica plantaginea* E. James (White River coraldrops), and *Penstemon barbatus* var. *torreyi* (Benth.) A. Gray (Torrey’s penstemon).

***Jamesia americana* Torr. & A. Gray (fivepetal cliffbush, waxflower)**

Although the locality is unknown, James also collected the type specimen of a species which belonged to a genus that had yet to be described to science and that would bear his name. *Jamesia americana* could have been collected anywhere along the Front Range from Adams into Fremont County, based on this species’ distribution and the expedition’s route. An attractive plant with toothed leaves and clusters of large, waxy white or pink flowers, waxflower is abundant today ▶



Clockwise, from upper left: *Eriogonum umbellata* Torr. (sulphur-flower buckwheat), *Sedum lanceolatum* Torr. (spearleaf stonecrop), *Penstemon barbatus* var. *torreyi* (Benth.) A. Gray (Torrey’s penstemon), *Pseudostellaria jamesiana* (Torr.) W.A. Weber & R.L. Hartm. (tuber starwort), *Veronica plantaginea* E. James (White River coraldrops) © Jen Toews. *Heuchera bracteata* (Torr.) Ser. (Rocky Mountain alumroot). © Mike Kintgen



Jamesia americana Torr. & A. Gray (waxflower).
© Nick Daniel

◀ on rocky slopes and in rock crevices along the east side of the Front Range.

A Botanical Enigma

Somewhere between the Platte Canyon and present-day Air Force Academy, James made note in his diary of *Ostrya virginiana* (hop hornbeam). This is a botanical mystery since this taxon is not part of the known contemporary flora of Colorado. Further complicating matters, there is no specimen collected by James at the New York Botanical Garden, where the majority of his herbarium specimens are housed. However, James mentioned this species both in his *Account* and his *Catalogue*.

What did James actually see on the shoulders of the Palmer Divide, an area known to house several eastern disjunct populations? (It is worth noting that this area also contains other botanical mysteries including the sensitive fern *Onoclea sensibilis*, which has not been seen since the 1940s.) Could it have been a member of the *Prunus* species? Or was it the native *Corylus cornuta* (beaked hazelnut), an eastern disjunct itself? Or did James indeed stumble upon a disjunct population of *O. virginiana*, one that was subsequently destroyed by a fire or some other natural cause? It is interesting to note that disjunct populations of *C. cornuta* and *O. virginiana* occur together in moist canyons in the Black Hills of South Dakota and that *Betula papyrifera* (paper birch) has disjunct populations in both Colorado and the Black Hills. In any case, we can only speculate about the species James saw.

Some mystery surrounds July 11 as it is not mentioned in James's diary. However, in his published *Account* of the expedition, James writes that at sunset on this day the expedition party realized they had passed Pikes Peak. Thus, on July 12 James retraced his steps to try to gain access to Pikes Peak, which is

the subject of Part 3 of this series (to be published in the Summer issue of this publication).

Much has changed in the 200 years since the Long Expedition traveled through present-day Jefferson, Douglas, and El Paso Counties. Would the party even recognize this area of Colorado today? A four-lane highway now follows the South Platte to the Lockheed Martin campus. Chatfield Reservoir obscures the union of the Platte River and Plum Creek, creating a recreational lake full of boaters and swimmers in the summer. Further south, urban sprawl continues to eat away at the remaining open spaces between Denver and Colorado Springs. Much of Long's route south of the Palmer Divide has been covered over by Peterson Air Force Base and the western suburbs and bedroom communities of Colorado Springs.

As for the "Chasm of the Platte" (Waterton Canyon), Denver Water facilities and the headgate of the High Line Canal all have infrastructure there. A smooth dirt road follows the Platte River for 6.5 miles through its chasm, replacing the slow and treacherous bushwacking that James and his party experienced. Today, the road is full of hikers (it is the start of the 485-mile Colorado Trail), as well as runners, strollers, mountain bikers, anglers, and wildlife enthusiasts.

Yet much remains the same. All but one of the plants James mentioned (*Ostrya virginiana*) are present and accounted for in Colorado's flora. Rocky Mountain maple continues to grace streams, ravines, and dry forests, while boulder raspberry, mountain ninebark, and waxflower light up the foothills with their flowers each spring.

The wildflowers James described to science—sulphur-flower buckwheat, spearleaf stonecrop, Torrey's penstemon, Rocky Mountain alumroot, tuber starwort, and Colorado columbine—are still celebrated by plant enthusiasts. As for geology, the hogbacks of Roxborough State Park and the tablelands of the Palmer Divide still rise above forests of ponderosa pine and Gambel oak. And, in the distance, Pikes Peak, the monarch of the area, still dominates the skyline.

Mike Kintgen is the curator of alpine collection at Denver Botanic Gardens. His work has taken him across the globe to biomes similar to the Rocky Mountains and steppes of western North America. He greatly enjoys working with regionally native flora and learning the botanical history of Colorado.

Jen Toews works in the plant records department at the Denver Botanic Gardens and is a Colorado Native Plant Master® who advocates for native plants at every opportunity. In her free time, she enjoys expanding her native plants garden, hiking to see native flora, photographing native flora, and writing.

"Long Expedition ..." continued on page 16 ►

Featured Story

From Desert Dust to Mountain Snow to Desert Plants: Observations on the Complexity of Native Plants

By Michael Remke

Spring. Wind howling. Tumbleweeds bouncing across lonely stretches of desert highway. Red sand riding air currents like snow: desert dust.

Anyone who has spent time in the greater Four Corners Region knows the region's distinct geology is memorable. Envision large undulating dunes of red rock. The wind sets grains of sand free here. It always has, leaving behind the fluid marks of atmosphere. Today, however, such events are exacerbated due to land use changes. Intensive grazing. Off highway vehicle use. Oil and gas. Droughts from climate change.

Sand getting blown up into the atmosphere creates dust storms that are generally carried on the region's strong southwest winds, transporting dust to the northeast where the rise of the San Juan Mountains serves as a catcher's mitt for the atmospheric disturbance. In spring, the result is desert dust landing on mountains blanketed in snow.

After such an event, the mountains are left with coats of red draped on their white undergarments. Snow tends to reflect the vast majority of incoming solar radiation. Dust tends to absorb a lot of energy. Once dust is on snow, the energy absorbed by dust begins to melt the snow surrounding it. Even when buried, this can cause snow to rapidly disappear, sometimes causing snowmelt up to two weeks earlier than normal. Such phenomena of physics can contribute to shifts in snow stability and heightened avalanche risk,



Dust covered San Juan mountains on an April day.
© Mike Remke

and can alter the amount of water that infiltrates soil. That runoff in streams evaporates to the atmosphere and, of course, if snow melts earlier, it can contribute to a longer-growing season for plants.

NASA first noticed this pattern and, in partnership with the Center of Snow and Avalanche Studies, began tracking dust events and modeling the impacts on water. They found dust could reduce water supply in the Colorado River Basin by up to 14%. They also sampled sediments in alpine lakes and, indeed, found that dust from the desert regions of the Colorado Plateau occurred in lake sediments with greater frequency since the 1980s than in the decades or centuries prior. Such findings led me, and my undergraduate research advisor, Julie Korb, to question how alpine plant communities respond to accelerated snow melt.

Summer. It was August when I visited the site. The sun was warm and intense, the air cool with moisture evaporating off the dense green vegetation of an alpine slope. Looking across the slope, yellows, purples, pinks, and whites were vibrant against the green and beneath blue skies. Tall poles rose above everything marking the corners of my experimental plots. I had been there every third day since snowmelt observing the phenology of every plant. Even prior to snowmelt, I came and put large black fabrics across portions of the site to mimic dust that accelerates snowmelt. My connection to this site was becoming intimate, and my manipulations to it were beginning to reveal some patterns.

Interestingly, I observed species that were common at many elevations, not just the alpine—such as ►



Navajo Sandstone features on the Colorado Plateau is a rock layer that was once a giant field of sand dunes. © Mike Remke

◀ *Noccaea fendleri* (candytuft) and *Taraxacum officinale* (dandelion)—flowered based on timing of snowmelt and set seed at generally the same time regardless of when they flowered. In contrast, plants only found in the sub-alpine or alpine, like *Polemonium confertum* (sky pilot), timed both their flowering and seed set based on a fixed amount of time after snow melt. If snow melts early, these alpine specialists often flowered early, often so early that drought stress during the end of June prevented plants from ever producing seed. In such a circumstance, generalist species almost always still produced seed. One can imagine then, if such a phenomenon occurred year after year, the alpine plant community may shift to having more generalists than specialists. For me, such an interpretation of a finding was devastating. I had fallen in love with plants by doing this project, learning the flora of the alpine.



Vast wildflowers bloom in Colorado's alpine.
© Mike Remke

I became someone who spoke for the alpine flowers. I would go to conferences and share this story to speak of how desert dust was potentially hurting alpine plant communities. A couple of times, I was asked how can we prevent desert dust. I often answered with the simple response of suggesting eliminating the problems: stop grazing, don't allow OHVs, and don't develop for oil and gas. These answers all felt vaguely disappointing until I met a man who offered his own solution.

"It seems this highlights the importance of restoring desert plant communities. I have been working on restoring the skin of the Earth by cultivating biocrust organisms in the greenhouse." Restoring the skin of the Earth. That was something that stuck with me. Further discussions with this man, Matt Bowker, led to a path of thinking about creative ways to restore desert plants, especially given the context of climate change. With warmer, drier conditions on the horizon, it was clear any restoration effort would be challenged by the associated increase in environmental stress.

So, we have journeyed from desert dust to mountain snow to desert plants. In essence, by taking it back to the grains of sand.

Restoring the skin of the Earth

Matt's work focuses on growing organisms associated with desert biological soil crust communities, which includes things like cyanobacteria, lichen, and moss. These cryptic organisms are filamentous and live in the top few centimeters of soil, their filaments anchoring grains of sand and preventing erosion. Below these top centimeters of soil, an even smaller complex organism plays a critical role in stabilizing soil. It is mycorrhizal fungi. "Myco" is derived from fungus, "rhizal" comes from rhizo, which means root. These fungi live on or inside of plant roots and are associated with over 80% of land plants. Many evolutionary biologists think the relationship between these fungi and plants is so strong that they co-evolved. Indeed, fossils indicate the first land plants had mycorrhizal associations. These fungi receive carbon from plant photosynthesis and, in exchange, offer the plant soil resources like nitrogen, phosphorous, or even soil water.

An interesting thing about plant restoration programs is their focus on plants; perhaps by not reintroducing mycorrhizal fungi, they are setting up plants to fail. Which begs the questions: Do mycorrhizal fungi improve the success of artificially planted desert plants? If so, might they help plants survive more stressful conditions as a result of climate change?

Fall: It was a chilly November day, yet the sun and wind had a similar intensity: unforgiving. It carried the loose cinder soil in the air and blasted my face with repeated mini-dust storms. I was harvesting plants I grew from seed (with and without mycorrhizal fungi) at

"Desert Plants ..." continued on page 16 ►



Bouteloua gracilis (blue grama grass) grown with its mycorrhizal associates at a site that is two degrees warmer than the seed source location.
© Mike Remke

Featured Story

Cultivating Connections Through Nature Journaling

By Heidi Skiba

I settle into my camp chair on the edge of the trail, sketchbook on my lap and pencil in hand. Thoughts of unanswered emails and my growing to-do list fade away as my attention focuses on a pink geranium in the tall grass.

My pencil moves across the page as I try to capture the shape of the petals and the details of the foliage. Suddenly a tiny character appears in the scene: a light-green crab spider delicately travels across a tightrope of silk from another plant and settles at the center of the blossom. There it sits quietly until other insects visit the flower—first, a bright-green bee and then a fly. At first, I think the spider is chasing these individuals off until I realize it may actually be stalking them.

Questions about what I am observing dance through my mind and I realize I am completely absorbed in this unfolding drama. I reflect on what it must be like to be that spider in its home of plants and silk-strands and wonder what other characters are part of this tale. Soon



Surrounded by bright pink fireweed, I sketch Rabbit Ears Peak near Steamboat Springs in my journal.
© Doug Skiba

my journal page is full of notes and drawings and I feel a kinship with nature in this small space and beyond.

Nature journaling can cultivate a deep bond with the natural world through personal reflection and close observation. I felt that connection myself when creating the spider journal page. Create your own bond with nature by keeping a journal.

What is a nature journal?

A nature journal is a place to record observations and

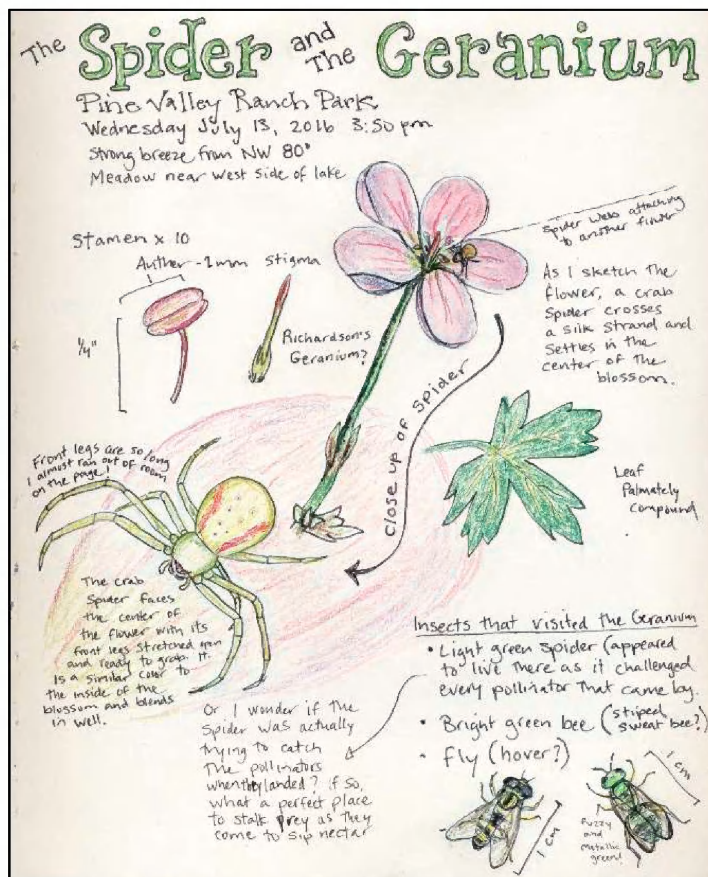
reflections about the natural world. Your journal might incorporate elements of a field guide in which you keep track of species sightings and notes. It could be part travel notebook where impressions of distant lands are chronicled. You might even write diary-esque prose that captures the happenings of a day in nature and how your encounters intersect with other happenings in your life. A poem inspired by a quiet moment in your neighborhood park might also find its way onto a page.

Many nature journals also include drawings. Though you can absolutely keep a nature journal with only written words, sketching on its pages will enhance your observation skills. You will inevitably notice more about your subject matter when looking closely and trying to capture lines, shapes, and textures with your art materials. On top of that, keeping a nature journal is a wonderful way to develop creativity and improve drawing and painting skills. However, the purpose of a nature journal is not to create gorgeous works of art (though you may find that happens in your pages with practice). The goal is to observe, record, and contemplate the world around you.

From scientific notes to creative writing, drawing, and poetry, your nature journal is unique to you. There are no limits on what you can include.

Basic materials for nature journaling

You don't need a lot of fancy supplies to nature journal. A sketchbook, pencil, waterproof felt-tipped pen, and something to add color (such as ►



The story of the crab spider and geranium unfolds on Heidi's journal page. © Heidi Skiba

◀ watercolors or colored pencils) allow you to record endless subjects in your journal with words and drawings. Make sure to choose a sketchbook that has suitable paper for the materials you want to use. For instance, if you want to try ink or watercolors, make sure your paper is thick enough that these won't bleed through the page.

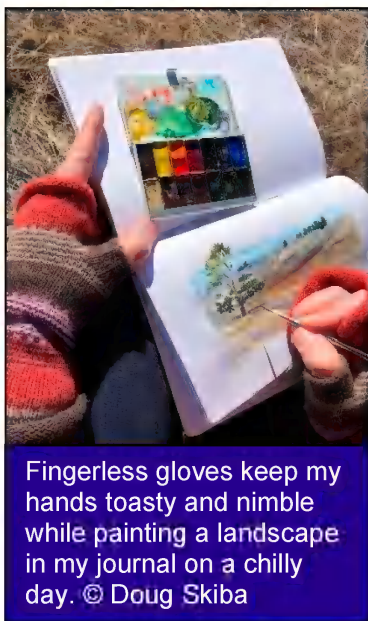
As far as journal sizes, a large book will allow you to include a lot of observations and notes on each page. However, you may end up leaving it behind because it is too heavy. A small journal is nice for traveling, but your writing and drawings may feel cramped. Try to find a balance that best meets your needs, or consider getting different sizes to carry for various activities.

Once you acquire your supplies, keep them ready to go in a shoulder bag or backpack so you can easily grab them to head out on a nature journaling adventure.

What to put on a journal page

There are countless ways to approach a nature journal session and it can be difficult to know what to put on a page when you first begin. I suggest keeping it simple for your early excursions. Start by choosing a location and taking a short walk to absorb your surroundings. As you stroll along, something will usually grab your attention and spark your curiosity. Use this as the focus for your page.

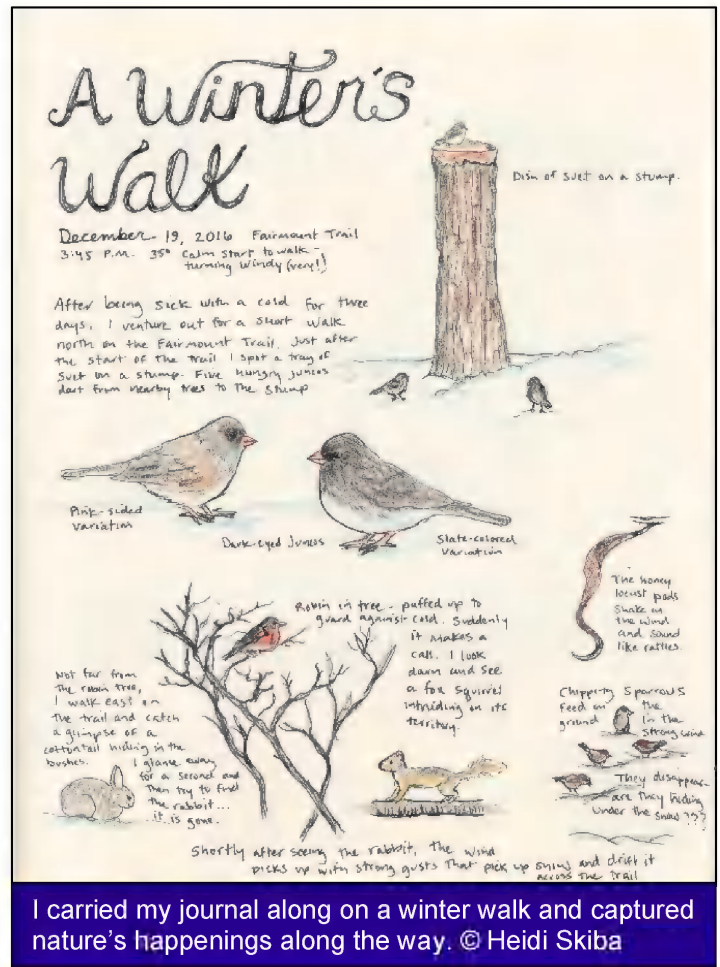
Begin by recording the place, date, time, and weather conditions somewhere on the page. Next, sketch different views of your subject from close-up and far away and include a sketch of the surrounding habitat. Add notes about the details you see (such as sizes, patterns, and colors) alongside the drawings.



Fingerless gloves keep my hands toasty and nimble while painting a landscape in my journal on a chilly day. © Doug Skiba

completed page that perfectly captures everything you witnessed during that unique moment in nature.

Do any questions pop up as you are investigating your subject? Jot them down. Write about any relationships you notice between your subject and other things in the surrounding environment. Describe things you experience from senses other than sight, such as sounds and smells. Reflect on your own feelings in nature that day and include those on the page. Before you know it, you will have a



I carried my journal along on a winter walk and captured nature's happenings along the way. © Heidi Skiba

Benefits of nature journaling

There are many perks to keeping a nature journal. Here is a short list:

- **It allows us to slow down and better notice the world around us.** Many of us go on outdoor excursions where we rush along the trail in an attempt to reach destinations and we certainly see things along the way. By stopping to closely record the natural world in your journal, you will witness a far greater number of details because your attention is focused.
- **It helps us learn about the natural world.** The details you notice when journaling can make you curious about your subject matter and compel you to investigate something further. This can take you on an amazing journey of discovery. It can also be a tool for identification. Unsure which species you are observing? Taking notes and making drawings will help you see unique identification characteristics which you can later use to figure out what you saw.
- **It is relaxing.** The world today travels at a fast and stressful pace. Writing and sketching in a journal has a calming effect. It allows you to focus on what is happening right in front of you in nature at that given moment instead of worrying about the future or the past.

• **It can help us be good stewards.** The relationship we build with nature through journaling can lead to an attitude of care. For instance, someone might be more likely to work to conserve a piece of land after they have observed and recorded things about the flora and fauna living there. A journal also becomes a first-hand and lasting record of what is happening in the natural world. You can go back into its pages to evaluate patterns and changes in the environment or assess subtle eco-relationships between species that may have gone unnoticed before. This can lead to actions to preserve and protect our natural world.

After putting some final notes on my page about the crab spider and geranium, I close my sketchbook and look around. Their story was just one of many in a single meadow. Had I examined an area six feet to the right, I likely would have noticed something entirely different, but just as intriguing. What other wonders were waiting to be revealed through journaling? Every time I explore one small area of this world with my journal, my bonds with nature strengthen, and I am inspired to care for our earth and help others to do the same.

Heidi Skiba works as a park ranger for Jefferson County Open Space and is a Colorado Native Plant Master®. She loves using art to help visitors of all ages connect with nature and embark on a path to stewardship. In her free time, she enjoys going on outdoor adventures with her husband, nature journal always in hand. ☯

From Platte to Peak

A celebration of the Plants Collected by Edwin James in 1820

To celebrate the anniversary of the Stephen H. Long expedition, the Rocky Mountain Society of Botanical Artists is hosting an exhibit later this year that will focus on the plants collected by James.

Artists are encouraged to submit entries in their media of choice by August 15. For more information, visit

<https://www.onlinejuriedshows.com/Default.aspx?OJSID=44170> ☯



Nature Journaling Resources

By Mary Menz

Want to learn more about nature journaling? In addition to numerous books on the subject, there are numerous resources at your fingertips online. For example, John Muir Laws hosts a website, newsletter, blog, and books.

Laws was raised by nature-loving parents and chose a career as a wildlife biologist. As a trained observer, Laws puts his attention to detail to work as an illustrator and educator. He is the author of several books including *The Laws Guide to Nature Drawing and Journaling* (2016). He is an advocate of journaling as a tool to record observations and noting relationships between living things such as plants and birds or insects. He stresses that people do not need to be artists or naturalists to nature journal. Visit the website at <https://johnmuirlaws.com/nature-journal-club/>.

Numerous towns and cities in Colorado offer nature journaling courses or experiences. None require previous experience. Check out your local park guides for opportunities near you.

Jeffco Open Space Nature Journal Club

Learn sketching tips and practice nature journaling at free monthly programs with Jefferson County Open Space. Times, topics, and park locations vary. Visit

<https://www.jeffco.us/1568/Educational-Programs> for more information and to register.

May 30: Single Day Sketch and Learn Wildflower Walk

Native Plant Master® Program

8:00—11:00 AM, Lookout Mountain Nature Center

Take a spring wildflower walk and stop along the way to learn how to identify common flowers and practice techniques for sketching them. Visit

www.jeffco.us/1568/Educational-Programs to register.

Nature Journaling and Mindfulness

<http://csuhort.blogspot.com/>

Urban Prairies Project: Habitat Restoration and Community Health

By Amy Yarger

Urban open spaces do so much for Colorado's growing population, providing ecosystem services while also preserving quality of life and a sense of place. The link between nearby natural areas and human health is reinforced by a traditional association between the beauty of nature and healing.

In 2013, the American Public Health Association officially recommended that land use decisions should prioritize the preservation and restoration of natural areas and green spaces for people of all ages, income levels, and abilities. There's even evidence that these natural areas help our mental health. Researcher Stephen Kaplan has shown that vegetation and nature reinforce our spontaneous attention, allow our minds to relax, and infuse us with fresh energy. According to a 2014 survey in Broomfield, Colorado, a significant majority of residents regularly visit open spaces and report placing a high value on these natural areas. With all of that love for open spaces, it's especially important that residents return the love and ensure the health and longevity of these parks, especially since many face challenges from flooding, erosion and invasive species.

In 2016, Butterfly Pavilion, the City and County of Broomfield and the City of Westminster launched the Urban Prairies Project to do just that. The growing communities of Westminster and Broomfield currently manage over 11,000 acres of open space parks and

trails. These trails receive heavy use throughout the year, and 80% of residents in Broomfield report that they visit open space parks, with over half visiting more than 10 times annually. Effective habitat restoration plays a central role in maintaining these sites for the community to enjoy. While restoration is currently a priority in these communities' open space management plans, limited personnel and resources consistently challenge the effective management of these urban parcels.

UPP improves the ecological health of open spaces in the Colorado Front Range, while providing opportunities to engage the local community in habitat conservation. The collaboration does this by establishing native plant communities that support ecosystem services such as pollination and water quality. Another important component of the collaboration is to raise awareness about the importance of these spaces and to engage people from all walks of life in their stewardship. UPP has grown significantly, and what started as a pilot project has now become the foundation for Butterfly Pavilion's future facility in Broomfield. The project partners aim to create replicable models of long-term, sustainable habitat restoration in the areas where people live, work, and play. This is especially important as the world's population moves towards greater urbanization, and wildlife habitat becomes more disturbed and disconnected.

Each year, UPP partners work together to identify habitat restoration priorities throughout park systems. They then develop a comprehensive scope of restoration work for each project. However, resources for habitat restoration are often stretched thin over thousands of acres of open space in each community. In order to have the capacity to successfully implement these restoration projects, the UPP partners created an avenue for interested members of the community to build expertise and participate directly in restoration, the Restoration Master Volunteer program. This program makes the most of an abundant and valuable resource: people. RMVs contribute their time, enthusiasm and skills while leading restoration project days, collecting data about plants and wildlife, and engaging the public with information about their local open spaces. They also serve as passionate ambassadors in their networks, raising awareness about the natural world in their own neighborhoods. By training and leading other volunteer teams, these stewards extend the impact of habitat restoration to a larger audience.

RMVs come to the program from traditional and social media to neighborly word-of-mouth and public outreach events. RMVs are required to complete 25 hours of intensive classroom training, including subjects such as noxious weed management, wildlife monitoring, and ►



Restoration projects often happen within sight of local neighborhoods such as this one in Brighton, Colorado.
© Amy Yarger



Spring storms do not dampen the enthusiasm of restoration volunteers from Legacy High School in Broomfield, Colorado. © Kristina Schaad



Goat impact monitoring training is one of the available community science options at Standley Lake Regional Park. © Amy Yarger

◀ public outreach. Restoration Master Volunteers also complete an additional 25 hours of field training and shadowing within the first year. Volunteers can then pick and choose among a diverse array of restoration-focused projects and events based on what is the most convenient and meaningful for them. The volunteer team includes everything from “bird nerds” to volunteers who live for teasel eradication and milkweed planting. Volunteers report that they enjoy the opportunity to get the “insider’s view” of open space management and to learn more about native plants and wildlife in a social setting. These volunteers have astounded us with their knowledge, as well as their enthusiasm for the sometimes arduous physical labor of restoration. You know someone is committed to the cause when they are thigh high in mud during a May snowstorm and still smiling.

Since 2016, the Urban Prairies Project has trained 65 Restoration Master Volunteers, who have helped launch the restoration of over 100 acres of local open space in Westminster, Broomfield, and Brighton. The program has also started several monitoring programs to track the health and diversity of native plants and wildlife. The results of these community science endeavors help land managers to adjust their practices to promote more biodiversity. RMVs have made it possible for municipal land managers to follow trends in pollinator diversity and abundance, heron rookery success and the changes to soil in restoration areas. UPP has also worked closely with local schools, senior communities, and nonprofits, such as the Broomfield Open Space Foundation and Wildlands Restoration Volunteers, to involve more local residents in restoration work. A relationship with Legacy High School has resulted in twice-yearly youth service-learning projects, including planting native shrubs and collecting invertebrate diversity data at a site adjacent to the school. UPP also has an ongoing relationship with a 55+ community in Broomfield and regularly hosts native “seed-bombing” events along

the open space trails where the residents like to walk. We hope to accomplish even more with the Urban Prairies Project as we enter our fifth year. Currently, we are launching a pilot project with local communities to identify best practices for habitat restoration around the margins of prairie dog colonies. We are also doing more habitat restoration in riparian areas, since so many of our urban open spaces are centered on creeks, ponds, and lakes. Finally, we are applying many of the findings and lessons learned from this project to the efforts to create Pollinator Districts around Butterfly Pavilion’s new facility and other communities in Colorado. These districts support pollinators and their habitat through mindful landscape management in both urban and natural areas. We hope this expansion of the Urban Prairies Project will get even more stakeholders involved, eventually including local businesses, schools, and residents to create their own pocket habitats to provide connectivity to restored open spaces. This wide-ranging strategy can then serve as a basis for successful restoration efforts throughout the region, and eventually, healthier, more engaged communities in the Colorado Front Range and beyond.

We all have something to contribute to the health of our habitats. If you’d like to learn more or get involved with the Urban Prairies Project, please contact us at habitat@butterflies.org.

Amy Yarger has worked in the public horticulture field since 1996. She received a bachelor's degree in ecology and evolutionary biology at the University of California, Irvine, and then went on to study plant-animal interactions at the University of Michigan. Her master's thesis concerned the effects of invasive weeds on pollinator-plant relationships. Her efforts at the Butterfly Pavilion, where she has worked since 2000, touch on many of her passions: plants, insects, habitat conservation, and science education. Through habitat gardening and education, Amy hopes to create a closer connection to nature and a greater understanding about the need for biodiversity locally and globally. You can reach her at (720) 974-1874 or ayarger@butterflies.org 🦋

Garden Natives

The Rockbound Rose: Cliffrose (*Purshia stansburiana*)

By Jim Borland

Although not specifically confined to vertical landscapes, cliffrose is often found rockbound or in loose sandy or rocky soils of the Great Basin states. Visitors to the upper and lower reaches of the Grand Canyon may not have recognized this pinyon juniper woodland codominant plant whose range extends deep into Mexico. In Colorado, expect to find it in the southwestern corner of the state.

Important for northern desert and dryland landscapes because of its broadleaf evergreen nature, cliffrose couples this advantage with a prodigious and aromatic display of $\frac{1}{2}$ to $\frac{3}{4}$ inch-wide sulfur yellow flowers blooming from mid-May to mid-June. These blossoms completely hide the upper portions of the plant, which are perennially covered with small ($\frac{1}{5}$ to $\frac{3}{5}$ inch-long) and linearly divided, deep green leaves—either clustered or alternately arranged about the freely branching stems. The slight in-rolling of the leaf edge has been associated with the plant's increased ability to survive both dry air and soil.

After the flowers dehisce, they are replaced by 2 inch-long feathered achenes that create their own unusual, but attractive, display.

Southern ecotypes can attain a height of a small tree (24 feet), but northern types are usually less than 10-12 feet tall with similar width. Judicious pruning can keep heights lower with greater branching. The bark is aromatically glandular, becoming shreddy with age.

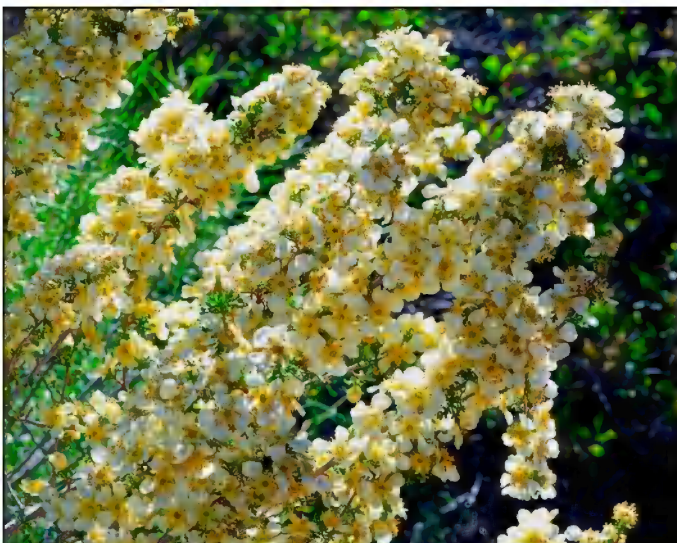
The cliffrose can survive with less than 12 inches of annual precipitation (including the occasional extended

droughts) and high pH soils (pH 7.5+); growth in typically low pH container soils presents no particular problem. A factor often limiting growth in common nursery soils and in the landscape is soil aeration. Apparently, the evolutionary movement of plants into the deserts from wetter climates has resulted in dryland plants that are no longer capable of maintaining good growth in moisture-saturated soils. With its almost 9-foot-deep roots, it needs no supplemental water in garden landscapes and thus is an excellent choice for the no-water garden.

Unusual for a rose family member, cliffrose has roots with nodules that host the nitrogen-fixing bacterium *Frankia*.

Winter low temperature survival is good in zone 5, its northern natural range, but zone 4 (-30°F) landscapes—natural and manmade—have successful examples of this species. Virtually all desert shrubs require full sun exposure for best growth and cliffrose is no exception.

Nearly all propagation is by seed, which benefits first from a one month moist and cool (35-41°F) period before germination. Stem propagation appears to be ►



Cliffrose (*Purshia stansburiana*). © Jim Pisarowicz



Purshia stansburiana seeds. © Jim Pisarowicz

◀ most easily accomplished with semi-hardwood 3-4" terminal stems basally treated with rooting hormone (0.8% IBA).

In the landscape, cliffrose requires little care, is bothered little by pests, and blooms reliably regardless of the lateness or severity of late frosts. Any necessary pruning must avoid cutting the shrub to the ground since it has little ability to stump-sprout. Expect individual plants to live to about 60 to 70 years. Mule deer and elk love to eat it.

Cliffrose was long recognized as *Cowania*, named after James Cowan, a British merchant and amateur botanist who was responsible for introducing many Peruvian and Mexican plants to England. Somewhat recently it has been moved to or returned to *Purshia* named after Frederick Traugott Pursh, author of one of the earliest floras of North America: *Flora Americae*

Septentrionalis. The specific epithet, *stansburiana*, honors Howard Stansbury (1806-1863), an American civil and topographical engineer.

Don't expect all cliffrose plants to look alike. There is strong evidence that it hybridizes with various populations of antelope bitterbrush (*Purshia tridentata*), with which it shares ranges. There is also evidence that both cliffrose and antelope bitterbrush may be the parents of yet another species, desert bitterbrush (*Purshia glandulosa*).

Jim has been fooling around with native plants for more than 40 years in private, commercial and public venues. His home garden contains thousands of native plants, most grown from seed at home and now not supplementally watered for 20 years. Jim has written hundreds of articles, given talks too numerous to count, and continues to grow and plant the two or three native plants not yet in his garden. ☯

◀ "Long Expedition ..." continued from page 7

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◀ "Desert Plants ..." continued from page 9

six sites across northern Arizona. After four years of experimentation, I started to understand that mycorrhizal fungi were critically important to plant survival in warm dry environments; however, when conditions were more favorable for plant growth, mycorrhizal fungi had a neutral or even negative effect on plant growth. On average, when I grew plants in warm dry environments

with their mycorrhizal fungi, I found about 150 meters of fungal hyphae (the filaments' root-like structure) in a single gram

of soil! Think about how much soil is stabilized by all that filament! And imagine the water and soil resources those hyphae can absorb that plant roots may not be able to gather on their own.

By becoming intimate with the diverse flora of the Colorado Plateau, I have truly found love in the deserts and mountains. These ecosystems are inherently connected. By the wind pushing storms, and dust across the landscape to rivers flowing off the high peaks and into the deep canyons, the mountains and the desert are in a delicate dance with one another. Similarly, plants do not live in isolation—they are in constant interaction with fungi, bacteria,

pollinators, and the landscape. Such lessons are rooted in the detailed observation of their lives during my experiments.

Through the rigor of academic culture, I have also learned how we come to understand life on Earth. The density of scientific literature and my own interpretation of numbers that represent more than six years of measuring the details of growing plants exposes one thing: science, and truth in science, is

complicated. Each experiment can only control for so many factors, every year is so unique, and each geography so different. It

can be exhausting to simply find the commonalities in the literature and make a decent interpretation from data.

From desert dust to mountain snow to desert plants: I love the complexity of the world and the beauty of native plants.

Mike Remke has lived in Colorado and the Southwestern United States for most of his life. After completing his BS in environmental biology at Fort Lewis College in Durango, he obtained his PhD from Northern Arizona University. Now he is the president of the SW Chapter and works at Mountain Studies Institute and Fort Lewis College as an adjunct professor. ☯

Restoration Roundup

Boulder's Goose Creek Channel Improvement Project

By Karissa Courtney

Boulder County and the City of Boulder have worked hard to protect the native lands around it. In 1898, Boulder County began acquiring lands and now owns 65,897 acres of open space land and holds conservation easements in 39,489 acres of protected private land. Starting in 1967, the City of Boulder began acquiring its own lands and now owns 45,000 acres of Open Space and Mountain Parks land in and around Boulder. Related to this are the wetlands of Boulder. These are few and far between in the dry Front Range and it is Boulder's goal to keep these special environments intact. Its wetland ordinance was adopted in 2009, protecting these resources. The Boulder Valley Comprehensive Plan and the Grasslands Ecosystem Management Plan also mention wetlands as valuable for their ecological role as a wildlife habitat, and promise continued action to protect these "historically scarce" areas.

Goose Creek is part of the important wetland system of Boulder. It is a four mile stretch of waterway, usually invisible to the passerby. It is hidden inside culverts, runs through backyards, and along established paths. It begins near North Boulder Park and flows eastward to the south of Edgewater Street. It joins Two-Mile Creek and Elmer's Two-Mile Creek near Folsom and Valmont. Further on, it joins Boulder Creek, which then connects to the South Platte River, making it a part of the Boulder Creek Watershed. It has been noted that Goose Creek is considered a major threat for flash flooding. These flooding events are not only bad for the people in the area, but also the riparian habitats that get washed away.

The Goose Creek Channel Improvement Project is helping to mitigate these flood events. Goose Creek has been filled in with sediment and plant growth, resulting in a non-discernable channel. This low-flow channel issue is a problem, as it results in frequent flooding of a heavily-trafficked public trail and has created a public safety hazard.

The project area is a narrow riparian strip along a 0.15 mile stretch of the Goose Creek, approximately 650 feet upstream from Foothills Parkway. This location was chosen for restoration due to the extreme sediment accumulation that can lead to flooding. Because of the creek slope, sediments have been accumulating here and have led to excessive cattail growth.

This project was proposed in May 2019 and began at the end of January 2020. There are many proposed channel improvements for this project and, of those, arguably the most important are the modifications to the channel itself, including modifying the grade,

realigning its course, and reshaping the channel to improve the water flow and reduce flood risk. A wetland bench or "buffer" will be included in these modifications. Buffers are **very** important in wetland ecosystems: they slow down and absorb the runoff (such as pesticides, fertilizers, bacteria from dog poop, and oil from roads) before it enters the stream, reduce and prevent erosion, and provide shade for the stream.

More shade will lead to reduced water temperatures.

In this area, there will be seeding and planting to provide natural wetland habitat. Additionally, there will be stabilization of the banks to ensure that water drains back into the creek without extensive erosion. The storm sewer pipes have already been removed and they will be reset below ground. Finally, improvements will be made to 21 feet of the path that runs alongside the creek. The total project was estimated to finish near the second week of April 2020 (although this is subject to change).

The project includes removal of 34 trees and 1500 sandbar willows. However, all disturbed areas will be replanted with trees and shrubs. The wetlands that occur within the project area are not particularly unique or scarce. The species found within the project

"Restoration Roundup ..." continued on page 21 ►



Research and Reports

Limber Pine Abundance and Ecological Role in Four Treeline Communities in Rocky Mountain National Park

By Laurel A. Sindewald, Eric R. Neumeyer, and Diana F. Tomback

CoNPS annually funds grants to support field and laboratory research as part of its John W. Marr and Myrna P. Steinkamp grant programs. Reporting on projects is a requirement of all grant recipients. In this issue, we are pleased to feature two reports.

Limber pine (*Pinus flexilis* James) is a five-needle white pine found at a broad range of elevations (Schoettle and Rochelle 2000) from northern New Mexico into southern Alberta, Canada, and from Colorado west into California. It tolerates droughty, windy conditions where other conifers are less likely to be found (Schoettle 2004), stabilizing steep slopes above the timberline and colonizing recently burned areas (Rebertus et al. 1991). The pine produces large, nutrient-rich seeds that are an important food source for wildlife (Lanner and Vander Wall 1980, Benkman 1995, McCutchen 1996), including Clark's nutcrackers, which cache the seeds in open areas across the landscape where they may germinate (Tomback and Kramer 1980, Williams 2017).

Limber pine is the only five-needle white pine in Rocky Mountain National Park and is considered a keystone species in the park (Schoettle et al. 2018). Limber pine is a species of management concern in RMNP (Schoettle et al. 2018) due to mountain pine beetle attacks beginning in 2007 (Connor et al. 2013) and a more recent threat from white pine blister rust in the park, a disease caused by the fungal pathogen *Cronartium ribicola* (Cleaver et al. 2015).

Limber pine has a patchy, metapopulation distribution in the park and across the Front Range (e.g., Peet 1978, Williams 2017). Bioclimatic envelope models predict that limber pine in RMNP will advance in elevation and shrink in overall range with changes in climate (Monahan et al. 2013), though more research is needed on limber pine ecology and biogeography to refine predictions. Limber pine's general distribution in subalpine forest in RMNP is known, but its distribution in treeline communities throughout the park is unclear.

Objectives

We were awarded the John W. Marr grant in 2018 with aims to determine 1) whether limber pine was present in tree island communities above Rainbow Curve Overlook in RMNP; 2) if limber pine acts as a tree island initiator or nurse object for other conifers; 3) if limber

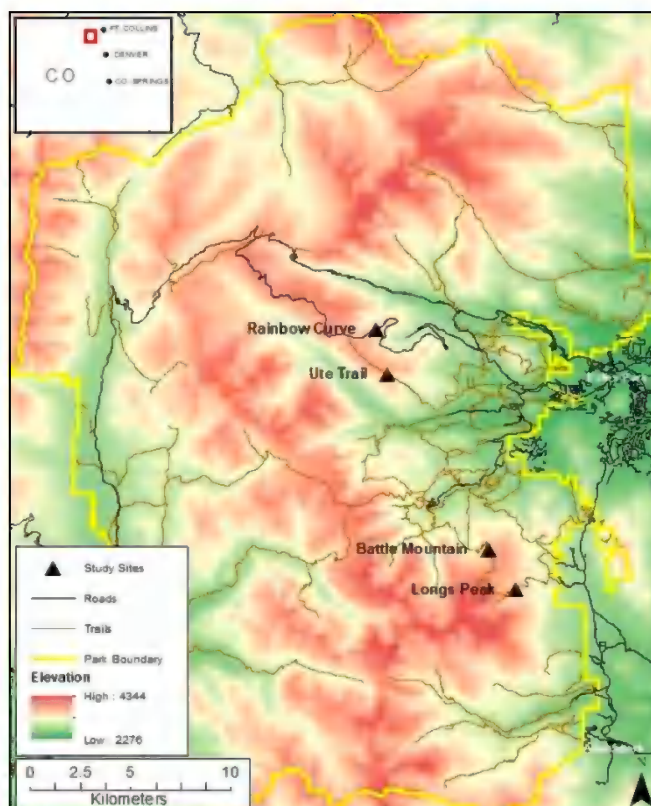


Figure 1. Map of study sites in Rocky Mountain National Park

pine can be predicted from subalpine seed sources; and 4) if there is evidence of infilling (suggesting treeline advance) at the Rainbow Curve site.

Methods

We determined quickly that limber pine was, indeed, present above Rainbow Curve Overlook. Aided by the Marr grant funding, we expanded our investigation beyond the ridge above Rainbow Curve Overlook to four treeline sites. Using shapefiles of subalpine limber pine from a 2005 vegetation survey in the park, we located four communities of limber pine at treeline and near trails or roads in RMNP (Figure 1, Table 1). We used a Trimble geolocator to map a perimeter around each of the study areas. In ArcMap (ESRI), we then used the Create Random Points tool to generate 40 random points within each site polygon, at a minimum of 5 m apart. In the field, we used the Trimble to find the nearest tree island to each random point for sampling. ►

Study site	Area (ha)	Mode elevation	Aspect(s)	Prevailing wind direction
Rainbow Curve	2.74	3376	NW	283° (WNW)
Ute Trail	6.62	3472	SE, E	282° (WNW)
Longs Peak	8.54	3410	N, NE, E	268° (W)
Battle Mountain	3.35	3456	N, NW, W	227° (SW)

Table 1. Characteristics of study sites in Rocky Mountain National Park.

◀ Trees with overlapping branches were classified as multi-tree islands, groups of krummholz trees growing together. Multi-tree islands generally grow along the axis of prevailing winter wind direction (Pyatt et al. 2016) with one or two trees at the most windward end acting as nurse objects for one or more downwind conifers. Trees growing alone but >1 m in their longest dimension were classified as single-tree islands. Single-tree islands are thus individual trees that were able to establish, survive, and persist in harsh treeline conditions without any facilitative benefit from other conifers.

We also created circular, 5-m-radius plots around the random point, or 5 meters downslope of the random point if the point fell within a tree island, and counted the number of solitary trees (defined as < 1 m in the longest dimension) of each species in the plots. Solitary trees are either younger trees than the single-tree islands noted above or are otherwise growing very slowly in harsh sites. The species composition of solitary tree plots tells us which species are best able to germinate and survive in harsh treeline conditions without facilitation from other trees. These plots also allow us to evaluate infilling.

We recorded the number of individuals of each species present in each tree island. Where possible, we discriminated individuals as having separate stems. Subalpine fir (*Abies lasiocarpa*, now known as *A. bifolia*) and Engelmann spruce (*Picea engelmannii*) grow in dense krummholz mats at treeline with clonal stems. Where contiguous, multi-stem patches of krummholz spruce or fir were identified, we counted groups of three stems as one individual to represent the species' proportional abundance accurately within each island. For each multi-tree island, we also determined which individual grew in the most windward position, which is presumed to have acted as a nurse object for other trees growing downwind.

We performed an odds ratio analysis to determine whether any species was more likely to be found in the most windward position (facilitating other conifers). Odds ratios compare the odds of one event occurring (for example, limber pine being found in the most windward position) to the odds of another event occurring (another species found in that position). If either event is equally likely to happen, the odds ratio will be one.

Results

We determined that limber pine did act as a tree island initiator (it was found in the most windward position of some islands), but not significantly more often than Engelmann spruce or subalpine fir at any of the sites (Figure 2). Where a line representing a 95% confidence interval crosses the horizontal black line at one, there is no significant difference in the odds of finding either species in the windward position at the 0.05 significance threshold.

While all four sites were directly upslope of stands of subalpine limber pine, we found that conifer species composition varied across the four treeline study sites (Figure 3). Limber pine abundance in single-tree islands (trees > 1 m in the longest dimension) was significantly greater than subalpine fir or Engelmann spruce at the Battle Mountain and Longs Peak sites. However, at the Rainbow Curve and Ute Trail sites, no significant differences in single-tree island species abundance were found. Species abundance was not significantly different in multi-tree islands, with roughly equal composition of the three species across all four sites. The exception was the Battle Mountain site, where limber pine abundance was significantly greater than spruce or fir in multi-tree islands. ▶

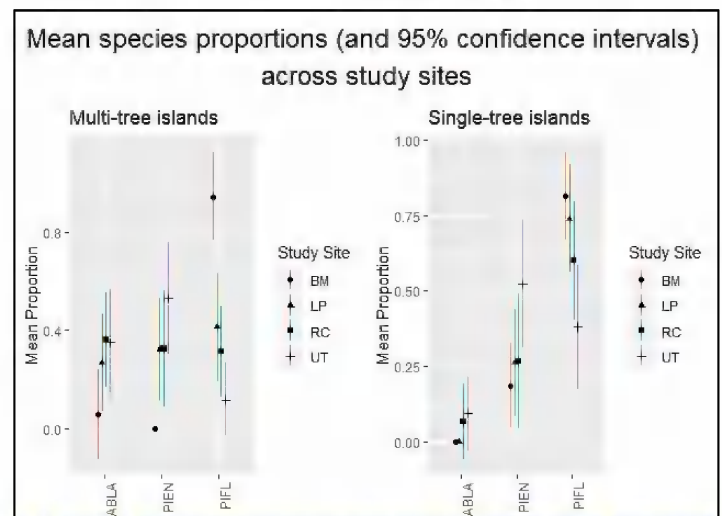


Figure 2. Limber pine acts as a treeline indicator, but not significantly more often than Engelmann spruce or subalpine fir at any of the sites. Species are subalpine fir (ABLA), Engelmann spruce (PIEN), and limber pine (PIFL) at the Battle Mountain (BM), Longs Peak (LP), Rainbow Curve (RC), and Ute Trail (UT) study sites.

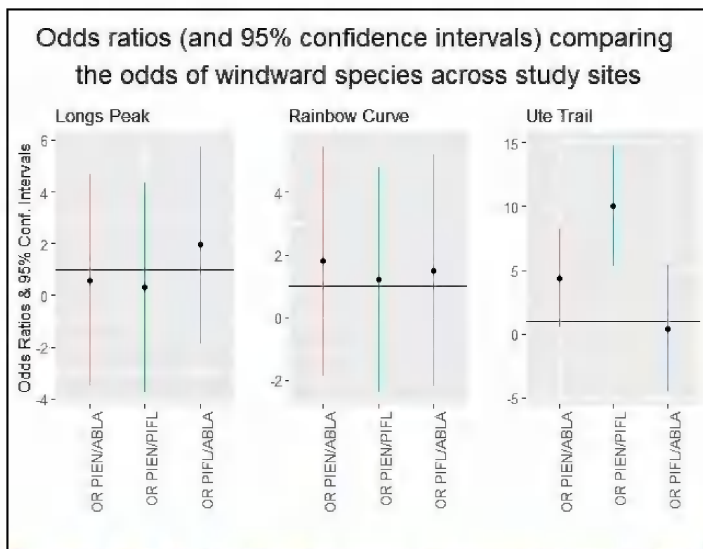


Figure 3. Conifer species composition varied across the four treeline study. Species are subalpine fir (ABLA), Engelmann spruce (PIEN), and limber pine (PIFL). Odds ratios were not calculated for the Battle Mountain site where 100% of multi-tree islands were limber pine.

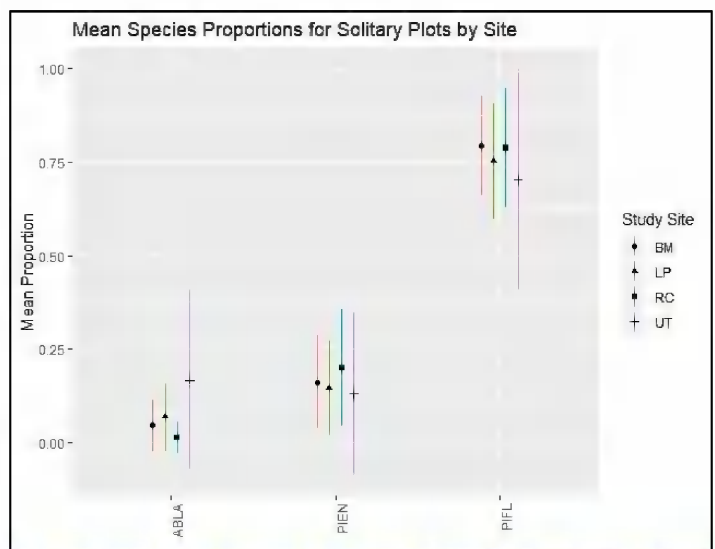


Figure 4. Abundance data from the solitary plots was more striking. Mean species proportions in solitary plots and 95% confidence intervals for subalpine fir (ABLA), Engelmann spruce (PIEN), and limber pine (PIFL) at the Battle Mountain (BM), Longs Peak (LP), Rainbow Curve (RC), and Ute Trail (UT) study sites.

◀ Abundance data from the solitary plots was more striking (Figure 4). Notably, limber pine comprised a significantly greater proportion of solitary trees across all sites than either Engelmann spruce or subalpine fir.

Conclusions

Limber pine's significantly greater prevalence as a solitary tree in all four communities shows it can establish and survive in harsh treeline conditions independently of other conifers. Limber pine's abundance as a solitary tree is likely due to the preferential caching of nutcrackers in open spaces (increasing dispersal into these areas above that of wind dispersed species), as well as its ability to tolerate drought and access deep water resources (Roberts et al. 2004). Overall, we found evidence of infilling in the presence and prevalence of solitary trees in our plots. Our results also suggest a shift in the community composition of treeline toward greater relative abundance of limber pine in the future at all four sites.

Limber pine was not found significantly more often in the windward position of multi-tree islands, suggesting that it is not acting as a nurse object more frequently than other conifers. At these sites, the odds of a species initiating a tree island may simply be linked to the species' abundance, with more abundant species initiating tree islands more often. For example, at the Battle Mountain site, where limber pine is more abundant, it was the only species found in the windward position.

With only four study sites it is difficult to parse out which variables could explain the slight differences in

the relative abundance of the three species at treeline (including distance to seed source). Future research will survey limber pine across the range of treeline communities in RMNP and identify key predictors for its occurrence and relative abundance at these high elevation sites.

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Laurel Sindewald is a PhD candidate in Diana Tomback's forest ecology lab at the University of Colorado Denver. She is using a combination of remote sensing and field work to determine covariates for limber pine's occurrence at treeline, and its potential to move upslope under changing climate. You can reach her at laurel.sindewald@ucdenver.edu. Eric Neumeyer is a former master's student from Diana Tomback's forest ecology lab at the University of Colorado Denver. He graduated in the summer of 2019 and currently works in ski area planning and National Environmental Policy Act compliance for a consulting firm in Frisco, Colorado. He can be reached at eric.neumeyer@ucdenver.edu. Diana Tomback is a professor in the department of integrative biology, University of Colorado Denver, and head of the forest ecology laboratory. She and her students study the ecology and conservation biology of five-needle white pines in the Rocky Mountains. You can reach her at Diana.Tomback@ucdenver.edu. ☿

◀ “Restoration Roundup ...” continued from page 17

site are found all over the riparian communities of Boulder Valley and Colorado. It is believed that these restoration efforts will increase structural and species diversity.

Wetland ecosystems are an important part of Boulder's ecology. They provide much of the species diversity and offer a unique habitat for otherwise missing organisms in the area because of our climate. This project will help protect this waterway for years to come by lessening the chance of flooding. It's exciting to see our community care so much about the nature surrounding us, and it will be great to see new plant and animal species take root in this newly restored area on Goose Creek.

This is a summary of a longer article on Goose Creek. Read the full article here:

<https://www.sharedpathsboulder.org/wp-content/uploads/2020/04/GooseCreekChannelImprovements.pdf>

Karissa received her BS in ecology from Seattle Pacific University in 2017 and currently lives in Boulder. She is a stewardship writer for the Shared Paths Boulder and also spends time collecting wildlife data for Boulder County Parks and Open Space. ☿

Plants used in this revegetation project (plugs, seed mix, hand plantings)

Swamp milkweed (*Asclepias incarnata*)
Showy milkweed (*Asclepias speciosa*)
Sideoats grama (*Bouteloua curtipendula*)
Blue grama (*Bouteloua gracilis*)
Emory's sedge (*Carex emoryi*)
Nebraska sedge (*Carex nebrascensis*)
Woolly sedge (*Carex pellita*)
Clustered field sedge (*Carex praegracilis*)
Red-osier dogwood (*Cornus sericea*)
Canada wildrye (*Elymus canadensis*)
Slender wheatgrass (*Elymus trachycaulus*)
Fowl mannagrass (*Glyceria striata*)
Needle and thread grass (*Hesperostipa comata*)
Arctic rush (*Juncus arcticus*)
Western wheatgrass (*Pascopyrum smithii*)
Fowl bluegrass (*Poa palustris*)
Plains cottonwood (*Populus deltoides*)
Wild plum (*Prunus americana*)
Skunkbush sumac (*Rhus trilobata*)
Golden currant (*Ribes aureum*)
Sandbar willow (*Salix exigua*)
Little bluestem (*Schizachyrium scoparium*)
Hardstem bulrush (*Schoenoplectus acutus*)
Three-square bulrush (*Schoenoplectus pungens*)
Prairie cordgrass (*Spartina pectinata*)
Alkali sacaton (*Sporobolus airoides*)
Sand dropseed (*Sporobolus cryptandrus*)
Snowberry (*Symphoricarpos occidentalis*)

Research and Reports

Alpine Plant Recovery from Heavy Trampling on a Colorado Fourteener

By Rachel Krebs

My research funded by CoNPS tells a story of disturbance to—and recovery of—alpine plants. It sheds light on how we can restore healthy alpine ecosystems that support diverse native plants, while meeting growing recreational demands. Popular fourteeners (mountains above 14,000 feet) in Colorado experience heavy recreational activity along hiking trails in alpine mountain areas, often causing significant soil erosion and loss of native plant diversity. Social trails, in particular, become problematic because they aren't planned by land managers, but rather are created by the public's continued use, so they are often in highly erodible and sensitive areas.

To address the threat that social trails pose to alpine communities, the Colorado Fourteeners Initiative maintains trail integrity and, at times, closes degraded social trails and replaces them with more sustainable trails that reduce erodibility from trampling directly on vegetation and soil. However, even when trails are closed, alpine recovery is not a given — alpine systems are notoriously challenging for plant growth due to high winds, fluctuating temperatures, long winters, and a short growing season. For this reason, the CFI tried a novel restoration technique, the re-introduction of vegetation plugs to degraded sites.

For this restoration trial, the CFI chose cushion plants, because they thrive in disturbed areas. Globally, there are 1,309 recorded species of cushion plants covering 63 plant families.¹ Cushion plants are cushion-forming plants found above treeline that earn their name from



Figure 1. Cushion plant drawing showing long taproot and dense dome canopy (Volkov & Volkova, 2015).

the dense dome of vegetation they create (Figure 1). Their dome structures buffer changes in temperature,⁷ provide wind protection,⁴ collect moisture,⁶ and increase nearby soil nutrients.⁵ As the cushion plants provide those services, they create microhabitats that facilitate other plant species, ultimately increasing species diversity.^{2,3} This natural occurrence could be used advantageously in revegetation efforts.



Figure 2. The stretch of the revegetated Old Denny Gulch trail on Mount Yale starts at 12,000 ft and ends at 13,200 ft. Pictured is Mike Kintgen, curator of alpine collections at the Denver Botanic Gardens, helping measure out transects where we recorded the abundance and size of cushion plants and grasses in the trail. © Rachel Krebs

Because of their ability to stabilize soil, draw deep water and nutrient sources with their long taproot, and buffer wind and temperature changes, cushion plants allow more species to thrive in harsh conditions. The CFI tested using plugs of mature cushion plants to revegetate a closed trail at Mount Yale. In 2011, the CFI closed the Old Denny Gulch trail, a popular social trail to Mount Yale's peak, and replaced it with a sustainable trail (Figure 2). CFI volunteers then transplanted plugs of mature cushion plants and grasses into the closed trail, and Dr. Catherine Kleier, my research advisor, has monitored the population of cushion plants and grasses ever since.

When we arrived at Mount Yale in 2018, we found almost all the transplanted cushion plants had died. While the cushion plants survived for the first four years, by the final monitoring date in 2018, they had all died. Therefore, long-term monitoring of sites like these becomes so important to get an accurate picture of success or failure. It is likely that the long taproot cushion plants depend on was cut off when mature plants were transplanted, leaving them without sufficient water and nutrients. Surprisingly, a lot of young cushion plants colonized in the final year. It is unclear whether the seedlings established from seed from the nearby community or seed from the transplanted cushion plants. So, while transplanting mature plants may not work well, we saw a lot of cushion plants coming in on their own. They are still strong colonizers, and while it hasn't been explored much previously, I think efforts should focus on sourcing local seed mixes for alpine plants rather than transplanting mature plants. ►

◀ We discovered six different cushion plant species in the trail (Figure 3). *Minuartia rubella* dominated the trail community, followed by *Minuartia obtusiloba* and *Silene acaulis*. While less dominant, *Silene acaulis* stood out as the cushion plant that supported the broadest range of native plants. These findings suggest that the cushion plant species that colonizes best isn't the one bringing in the most native plant diversity. Therefore, management efforts should focus on the species that provide the most plant cover because they will stabilize soil.

The process of succession (the change in community composition over time) takes a long time, especially in the alpine where plants grow slowly over many short growing seasons. It is likely that cushion plants are early successional species, present during the early stages to stabilize soil. As they stabilize soil allowing more species to grow, those new species will take over, and the early colonizers will fade. Therefore, long-term monitoring of this site is needed to better understand the community dynamics of alpine plants recovering from disturbance.

Mountains, wild places, and wildlife draw people to Colorado. Colorado needs to address a growing population and increased recreational use. This study is one of the first investigating how alpine plants

recover after recreational disturbance in Colorado's Rocky Mountains. Understanding the effectiveness of revegetation techniques and how alpine communities recover can improve our ability to better conserve protected places while maintaining recreational infrastructure and can be applied in mountain ecosystems across the world.

Rachel Krebs is a passionate researcher driven by questions of how we affect native ecology and how we can use plant biology to inform restoration techniques. In May, she completed her master's in environmental biology from Regis University, where she studied alpine ecology. She worked with research advisor Dr. Catherine Kleier on a long-term monitoring project at Mount Yale and was able to answer questions about the recovery and succession of alpine plant communities following disturbance and a novel revegetation technique. This research opportunity, funded by CoNPS, would not have been possible without the support of the Regis University biology department, Dr. Catherine Kleier, Mike Kintgen (curator of alpine collections at the Denver Botanic Gardens), the Colorado Fourteeners Initiative that tested a novel revegetation technique, and several volunteers who made the trek to the 13,000 feet elevation site at Mount Yale. Contact Rachel at (312) 231-5522 or kreb.rachel@gmail.com.

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Figure 3. The six cushion plant species recorded on the trail included three plant families. Clockwise from top left: *Minuartia rubella* (reddish sandwort), *M. obtusiloba* (alpine stitchwort), *Silene acaulis* (moss campion), and *Paronychia pulvinata* (Rocky Mountain nailwort) of the Caryophyllaceae family; *Phlox condensata* (alpine phlox) of the Polemoniaceae family; and *Trifolium nanum* (dwarf clover) of the Fabaceae family. All photos © Rachel Krebs; except for dwarf clover © Marina Poushkina; and Rocky Mountain nailwort © Marijn van den Brink.

Media Reviews

***Nature's Best Hope: A New Approach to Conservation That Starts in Your Yard* by Douglas W. Tallamy, PhD**

Reviewed by Suzanne Dingwell

In his new book, *Nature's Best Hope*, Dr. Douglas W. Tallamy has delivered a deep and powerful wellspring of inspiration for the many people craving an opportunity to be part of transformative change for our challenged world. Even more compelling than his first book, *Bringing Nature Home*, a seminal work in itself, *Nature's Best Hope* is a clarion call for the informed appreciation of native plants and the immediate course correction by using them in our own planting spaces to form the connected corridors that will help forestall the loss of species and the loss of ecosystem services that are we currently experiencing.

Nature's Best Hope is a richly-layered work, providing a contextual look at the evolution of our thinking about conservation, as well as detailed guidelines for getting started with native plants in your own nearby spaces, and, perhaps most importantly, the reasoning that will convince you, your neighbors, and your neighborhoods that now is the time to do so. Far from a dry treatise or an impassioned rant, the writing here reflects Tallamy's character: cautiously optimistic and gently, but perceptively, humorous. This book is an enjoyable read both for his fans and for those who are new to his ideas about the roles native plants play in our landscapes. One of his stated goals was to write a book that would meet the needs of three groups of people: those who like plants, those who like animals, and those who like neither. He has done so.

Of course, at the heart of this book is the depth of Tallamy's knowledge and experience. A professor for the department of entomology and wildlife ecology at the University of Delaware for over 40 years, author of more than 95 research papers, and a person ultimately qualified to make the arguments he does. Read the book cover for a list of awards presented to him.

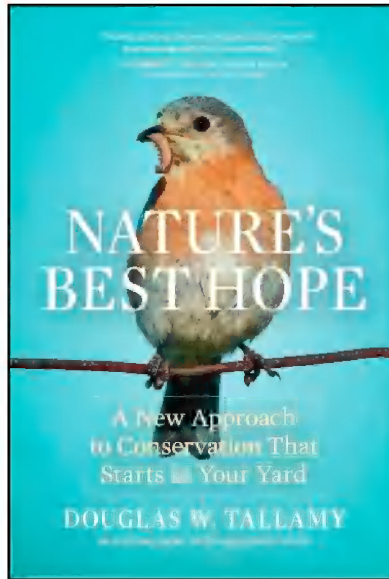
Tallamy's explanations of the specialized relationships between plants, insects, and animals are fascinating stories, but also foundational building blocks for understanding the natural world we live in—whether in the city, the country, or anywhere between.

Many significant changes have come about in our world since the publication of *Bringing Nature Home*. The words 'monarch decline,' 'climate change,' and 'the sixth extinction' have become part of the common parlance. In his new book Tallamy has taken the opportunity to address some of the common questions that have surfaced during this intervening time, including debates about the value of introduced plants and novel ecosystems, the feasibility of restoration projects, or the advisability of letting nature take its course. These issues and more receive detailed and clarifying explanations.

A core concept of the new book is an idea Tallamy calls the Homegrown National Park, one that is created by us, as individuals, with no need for new laws to be passed. Tallamy in no way minimizes the extent of the challenges we face, for he carefully quantifies all that we have lost in acres, in habitat, and in species. His mastery of details is what makes his idea of the Homegrown National Park so compelling. He notes that we have witnessed time and again how quickly nature can restore itself, and asks us to imagine how much more quickly she would do so if only we helped her. We have the power as individuals to do so. The connected corridors of our Homegrown National Parks have the potential "to restore some semblance of ecosystem function to more the twenty million acres of what is now ecological wasteland." That is significant.

Tangible evidence of results, even in the most unlikely of places, provides welcome success stories: monarchs and native bees on the High Line in New York City, 103 species of birds in a tiny yard half a block from Chicago's Kennedy Expressway, a grandfather and a toddler who are now loving and deriving the benefits of nature from time spent in their new richly diverse backyards with native plants.

When looking for specific advice within the book, highly visible chapter subdivisions make it easy to find exactly what you are looking for, such as an entire section on suburban yards. ►



◀ Another valuable feature is the FAQ section at the end. Just one example: in reply to the question, “Doesn’t this (planting natives) take more knowledge than the average homeowner has?” Tallamy replies in part, “In the 1980s we learned how to program our VCRs!” His full answer is more amusing and more edifying than time allows for in this review, but you can see how this section will be a handy reference for helping you answer the questions you will be getting, too. Toxic plants? Ticks? Yards too small? It’s too late to fix? Tallamy has you covered. Extensive illustrations, a comprehensive index, and a bibliography each add to the value of *Nature’s Best Hope*.

“Whether we like nature or not, none of us will be able to live long without it.”

In *Nature’s Best Hope* you will find the inspiration, the motivation, and the tools you need to help create our next National Park, it’s a positively electrifying read. Buy a book today. Or go to the publishers, **Timber Press**, and buy a box of them to share with key players in your life. I did.

Sue Dingwell started her native plant journey in Florida, where the revelation of what plants could do in the hot sand scrub was a transformative

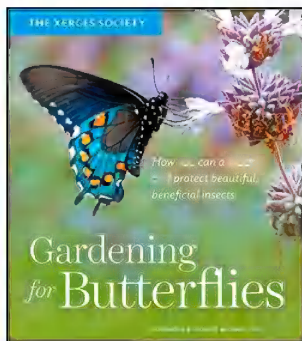
learning experience. She became a member of the Florida Native Plant Society and used her background in education to become a dedicated advocate of native plants and conservation. A Master Naturalist now in both Florida and Virginia, Sue is currently a member of both the Virginia and Colorado Native Plant Societies, and plans to be living in Colorado full time this spring. ☿

New Publications in the CoNPS Bookstore

Following are new titles added to the CoNPS online bookstore since January 2019.

<https://conps.org/conps-bookstore/>

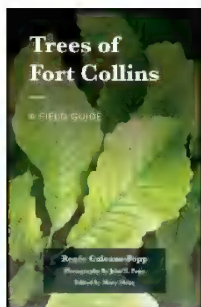
Gardening Books



Gardening for Butterflies: How You Can Attract and Protect Beautiful, Beneficial Insects

by the Xerces Society
Welcome the world’s most exquisite visitors to your garden! *Gardening for Butterflies*, by the experts at the Xerces Society,

introduces you to a variety of butterflies who need our help, and shows you how to design a habitat where they will thrive. This optimistic call to arms is packed with everything you need to create a beautiful, pollinator-friendly garden. You will learn why butterflies matter, why they are in danger, and what simple steps we can take to make a difference. You’ll also learn how to choose the right plants and how to create a garden that flutters and flourishes with life.



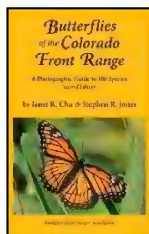
Trees of Fort Collins: A Field Guide
By Renée Galeano-Popp

Fort Collins, Colorado is endowed with a high diversity of trees primarily due to efforts of the City and Colorado State University. This book showcases this tree richness and captures the associated stories, anecdotes, and outstanding features of these species. Among them are

beautiful landscaping trees such as the colorful crabapples that line so many streets in full bloom each spring. Some are less obvious, contained in corners of the City Park or a business park. It contains over 220 species including seven state champions.

Renée Galeano-Popp is a botanist and retired forest ecologist. To inquire about presentations, events, and distribution, contact mtnpoppies@gmail.com

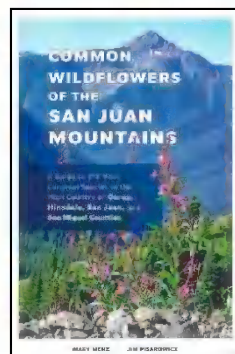
Native Plant Books



Butterflies of the Colorado Front Range: A Photographic Guide to 100 Species; 2nd Edition

by Janet R. Chu and Stephen R. Jones

This second edition was featured on page 25 of the Winter 2020 issue of *Aquilegia*.



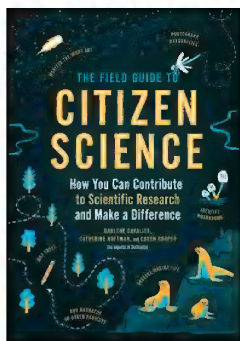
Common Wildflowers of the San Juan Mountains: A Guide to the Most Common Species in the High Country of Ouray, Hinsdale, San Juan and San Miguel Counties
by Mary Menz and Jim Pisarowicz, CoNPS Members

Organized by flower color, this guide provides quick identification of the most common wildflowers of the region. Compare the wildflowers

you find on your outdoor adventures with detailed photos of 123 species profiled in this book. Included are details about habitat, bloom times, elevation, and interesting facts about each plant found in the high country in Ouray, Hinsdale, San Juan, and San Miguel Counties. ►

◀ Also included in this book is a personal checklist to record the date and location of your observations.

Mary Menz (Ridgway) is an award-winning writer and a Colorado Native Plant Master®. Jim Pisarowicz (Montrose) is a locally recognized photographer of Colorado's flora. Together, they combined their personal plant lists from local hiking forays, with lists from other wildflower enthusiasts, to create the 123 most common species encountered in the spectacularly-beautiful place they call home.

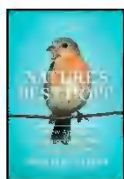


**Field Guide to Citizen Science:
How You Can Contribute to
Scientific Research and Make a
Difference**

by Darlene Cavalier, Catherine
Hoffman and Caren Cooper

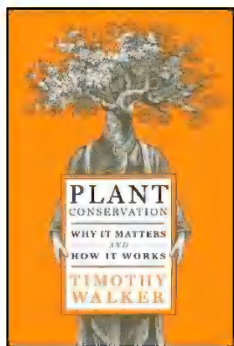
Learn how monitoring the night sky, mapping trees, photographing dragonflies, and identifying mushrooms can help save the world.

Citizen science is the public involvement in the discovery of new scientific knowledge. *The Field Guide to Citizen Science*, from the expert team at SciStarter, provides everything you need to get started. You'll learn what citizen science is, how to succeed and stay motivated when you're participating in a project, and how the data is used. The fifty included projects, ranging from climate change to Alzheimer's disease, endangered species to space exploration, mean sure-fire matches for your interests and time. Join the citizen science brigade now and start making a real difference!



**Nature's Best Hope: A New Approach to
Conservation that Starts in Your Yard**
by Douglas W. Tallamy

This book is reviewed in this issue of *Aquilegia* on page 24.

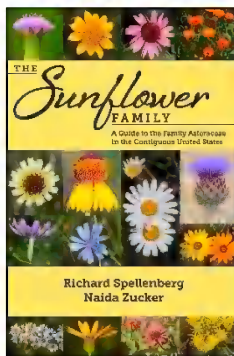


**Plant Conservation: Why It
Matters and How It Works**
by Timothy Walker

Plants' ability to turn sunlight into energy makes them the basis for all life; without them there is no life. And they are more than just a food source—they provide us with fuel, fibers, and pharmaceuticals. Global warming and the

destruction of natural habitats are a serious threat to many plants, and there are worldwide efforts to mitigate the disaster. *Plant Conservation* tackles this essential topic head on. Timothy Walker is director of the Oxford Botanical Garden, a leader in the field of plant conservation.

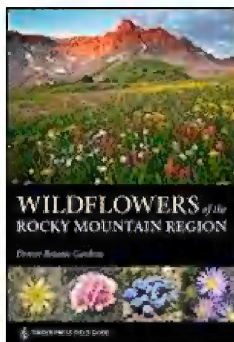
He highlights what is happening now, from cataloging the world's flora to conservation efforts like protecting plants from over-collecting. He also shows home gardeners how they can become involved, whether by growing their own food to decrease reliance on large agriculture or by making smart plant choices by growing natives and avoiding invasives. *Plant Conservation* treats a critical topic in an accessible and optimistic way. It is required reading for students, professionals, and anyone with a keen interest in the importance of plants.



**The Sunflower Family: A Guide to
the Family Asteraceae in the
Contiguous United States**
by Richard Spellenberg and
Naida Zucker

Developed for wildflower enthusiasts, students, land managers, teachers, and other non-professional botanists interested in plant diversity, this book is the only comprehensive

identification guide to the sunflower family of the contiguous US and southern Canada. Here, 1,765 photos help identify 428 genera and nearly 700 species of sunflowers, daisies, asters, and their relatives found outside of cultivation. From lowly cudweeds to lively daisies and statuesque sunflowers, the plants in this family are notoriously known as the NYCs (the darned yellow composites). This book includes geographic ranges, habitats, genus descriptions, and supplementary comments, with cross-referencing to similar genera in minimally-technical language. (Note: this book covers genus descriptions comprehensively, but because of the large number of species in this family, species descriptions are not covered in detail.)



**Wildflowers of the Rocky
Mountain Region**
by Denver Botanic Gardens, a
Timber Press Field Guide

From the Denver Botanic Garden, the region's recognized leader in horticulture—this book describes and illustrates more than 1,200 species commonly encountered in Colorado, Utah, Wyoming, Idaho, Montana, and the northern parts of Nevada, New Mexico, and Arizona. This comprehensive guide includes perennials, annuals, and bulbs, both native and naturalized, and is organized by flower color and petal shape. Introductory information includes an explanation of the plant parts, keys to the plants, and information on plant names. Species profiles include color photographs and range maps. ☼

News, Events, and Announcements

Please check the **Calendar of Events** online at <https://conps.org/mfm-event-calendar/#!calendar> for chapter meetings, garden tours, and other events. With the evolving COVID-19 situation, CoNPS will not host any in-person events through at least May. The status of future CoNPS events might also change.

CoNPS may offer some chapter meetings, workshops, and lectures as webinars or other online meetings. Others might be postponed or canceled. Field trips are also being scheduled, but may be cancelled or postponed. These will be posted online and will be promoted via the CoNPS E-News.

CoNPS Committee Reports

There are several committees that conduct various activities for members throughout the year. All committees are comprised of volunteers. To join any CoNPS committee, contact the committee managers via the CoNPS website.

The following committee reports summarize important work being done per the CoNPS mission statement.

Conservation Committee

By Linda Smith

The Conservation Committee tracks conservation issues by monitoring conservation websites, making comments on government management plans, promoting and encouraging members to participate in native plant conservation projects, and conducts special projects such as the Native Plant Conservation Campaign. This committee also works with other committees like the Field Studies Committee and the Restoration Committee on local projects.

This committee wrote letters and provided comments for the following:

- Re: Amendments of the Clean Water Act to the EPA strongly opposing the removal of wetlands, fens, small headwater streams and ephemeral/intermittent drainage waters from EPA regulations.
- Taylor Park Logging Proposal—Vegetation Management Project.
- Jack's Gulch Fuels Management Plan in the Canyon Lakes Ranger District. The Forest Service plans to thin the forest in order to reduce the build-up of fuels that generate forest fires.
- DRAFT EIS for Domestic Sheep Grazing Renewals, BLM Gunnison Office, asking the BLM to consider more than just their BLM Sensitive plant species in this EIS analysis. There are known occurrences of rare plant Species of Local Concern in this project area.
- NEPA Proposed Rule Comments - Forest Service's proposed revisions to regulations, 36 CFR 220, for implementing the National Environmental Policy Act.
- Comment to Colorado Parks & Wildlife regarding the Eldorado State Park Visitor Use Management Plan to ensure protection of *Carex sprengelii*, which may occur within the boundaries of the Park.

CoNPS comment letters are signed and written by Bayard Ewing, Conservation Committee chair. In some cases, letters were written or edited by members of the committee, including Gay Austin, Brad Klafehn, and others and then approved and signed by Bayard Ewing.

The committee also provided comment or added supporting signatory to other agency letters for:

- Dept of Interior's (DOI) Proposed Freedom of Information Act Regulations Proposed Rule, which, if adopted, would severely undermine government transparency, violate FOIA, and limit important public rights guaranteed by statute.
- Support of the use of native plants in NRCS Revegetation Projects. Letter was signed by 87 organizations expressing support for incorporating stronger guidance on the preferential use of diverse native plants to support wildlife, pollinators, and soil health in conservation practice standards.
- Brown's Canyon National Monument Resource Management Plan.
- Grand Mesa and Uncompahgre Revised Forest Plan. The Committee also submitted our own comments which had a somewhat different focus and can be found on a subsequent post.
- Letter from The Wilderness Society on Proposed Rule, National Environmental Policy Act Compliance.
- Powderhorn Fuels Management Project. Letter written by Matt Reed, Public Lands Director with High Country Conservation Advocates, and signed by fourteen other Colorado conservation organizations.

Additional advocacy activities included:

- Colorado Parks & Wildlife Roundtable—CoNPS is represented at the roundtable meetings by Brad Klafehn and Kristen DeLay.
- Committee members commented as individuals on the BLM March and June 2019 oil/gas lease sales, using rare plant information from Mo Ewing.

The committee also ensures that conservation projects are featured in each issue of *Aquilegia*, such as these from 2019: ►

◀ *Conservation Corner: Pawnee National Grasslands: An Important Conservation Area for Colorado's Biodiversity* by Crystal Cogar (Winter 2019)

- *A Tale of Two Wildflowers*, by Suzanne Dingwell (Spring 2019)
- *A Case for Preserving a River's Natural Character*, by Maggie Gaddis (Summer 2019)
- *Colorado takes the lead in protecting alpine plants in North America*, by Jennifer Neale (Fall 2019)

Chapter advocacy projects included, including assisting with Northern chapter: River's Edge Natural Area Demonstration Gardens in Loveland. Plants and supplies were purchased through a Larimer County grant applied for by Kathy Maher, project lead. The two gardens are thriving; signage will be installed in 2020. The northern chapter is monitoring the gardens and local advisory boards.

Education & Outreach Committee

By David Julie

This committee provides educational information and activities about Colorado native plants and natural landscapes both to CoNPS members and to the people of Colorado. Members of this committee specialize in:

- Planning collaborative events
- Presenting a variety of slide programs
- Developing lesson plans to use in classrooms
- Providing outreach through educational booths
- Leading interpretive hikes that focus on plant identification and general ecology for the young and old alike.

The following is a list of activities that occurred in 2019.

- Renee Galeano-Popp and Alice Guthrie judged student projects and selected four for awards from CoNPS at the Longs Peak Science and Engineering Fair (regional science fair).
- David Julie presented a program about flowers, butterflies, bees, and native plant gardening to three 2nd grade classes at Eldorado K-8 school in Superior-Louisville. He also provided native plant seeds.
- David Julie and Kate Goes In Center offered a Habitat Hero/Wildscaping presentation in partnership with Audubon Rockies at the Morrison Nature Center in Aurora.
- John Vickery and Tamar Krantz provided instruction about native plants and led participants in a bioblitz at Barr Lake State Park.
- Julie and Kate Goes In Center presented a participatory program for children and adults about flowers and pollinators at the High Plains Environmental Center on the day of the CoNPS Plant Sale distribution.

- Jack Carter, Tom Zeiner, and David Julie staffed a booth at the Colorado Science Conference and gave a presentation on including native plants in the classroom to about two dozen teachers. Their presentation included photographs from Lenore Mitchell, Tamar Krantz, and Amy Yarger.
- John Vickery organized and recruited speakers for the Colorado Weed Network Fall Meeting.

So far in 2020:

- Lenore Mitchell presented a session on landscaping with native plants to the Wildflowers Garden Club in Roxborough.
- David Julie skyped with fourth grade students at Lone Tree Elementary about their seed bomb project. He also sent to them packages of native plant seeds and a native plant guidebook.

Research Grants Committee

By Stephen Stern


The Research Grants committee reviews applications for and selects recipients of small grants from the John W. Marr Fund and the Myrna P. Steinkamp Memorial Fund. These two funds honor the late Dr. John Marr, professor at the University of Colorado and first president of the CoNPS, and Myrna Steinkamp, a founding member of CoNPS who worked on behalf of the society for many years in a variety of capacities. These funds were established to support field and laboratory research on the biology and natural history of Colorado native plants. Fund recipients provide a report at the end of their projects for publication in *Aquilegia*.

The research grants committee awarded the following grants for 2020. The recipients and the title of their research projects are below.

Marr Grant Recipients

- Courtenay Ray: "Demographic response to climate change in the Rocky Mountain alpine"
- Emily Mooney: "How native host plant variation shapes a facultative ant-butterfly mutualism"
- Laurel Brigham: "Do microclimates and biotic interactions change the nature of range expansions?"
- Mason Taylor: "Variation in effect of insect herbivory on Platte thistle (*Cirsium canescens*) between biogeographic range center and edge"

Steinkamp Grant Recipients

- Bronwyn Taylor: "The reproductive ecology of *Astragalus microcymbus*"
- Emily Orr: "Population genomic analysis of the rare, narrow endemic *Astragalus microcymbus*"
- Haley Carter: "Linalool production in *Oenothera harringtonii* (Onagraceae): From genome to gene-flow" 

CoNPS Webinars

CoNPS is now offering webinars on a variety of native plant topics. CoNPS members throughout the state can take advantage of these exciting learning opportunities, all within the comfort of your own home! Sign up for the webinars on the CoNPS website.

The Biology of Pollination

Saturday, May 30; 9:30-11:30 AM

Presenter: Stephanie Mayer, PhD

Stephanie will provide an overview of plant reproductive biology in the context of pollination biology. Pollination occurs via diverse mechanisms including wind, animals, and water. Pollination is not just a flowering plant phenomenon—conifers and other gymnosperms also produce offspring via pollination. All of these will be addressed.

Stephanie Mayer received a PhD in botany at the University of California Berkeley, followed by a postdoctoral fellowship at the University of Chicago. She has conducted research in plant systematics and plant breeding systems in the Hawaiian Islands and California. Stephanie has been teaching plant biology classes at the University of Colorado Boulder for over 20 years and feels very fortunate to teach what she loves: plant anatomy, plant diversity and plant systematics.

Urban Prairie Virtual Garden Tour

Sunday, June 7; 1:00-2:00 PM

See Lois and William MacPhee's 2. acres of short grass prairie, and learn about North America's most endangered ecosystem, and how to convert your lawn to natives.

Plant Community Restoration Principles and Techniques

Saturday, June 13; 9:00 AM - 12:00 PM

Presenters: David Buckner, PhD, Carla DeMasters, MA, MS

This webinar will skip "theory," beyond an initial clarification of terms and conceptual goals. Discussion will then move directly to the nuts and bolts of how to get things properly and effectively done on the ground with details on soil suitability, seed mix development, seeding methods, the role and problem of weeds, methods of measuring vegetation, and implementing useful and reasonable performance standards. This webinar is designed to address the needs of beginners as well as those with more professional experience.

Dr. David Buckner is a field plant ecologist with 51 years of experience. He has conducted workshops for CoNPS on subjects including grass identification, sunflower family plant identification, soils, and landscape reconstruction since the early 1990s. He has spent five decades in the study and implementation of landscape and plant community reconstruction. David is an honorary lifetime member of CoNPS and has led many field trips for CoNPS.

Carla DeMasters has worked as an ecologist and botanist in the western US for more than 15 years. She is currently a senior ecologist with Corvus Environmental Consulting. She has an MS in geography from CU Boulder and a second MS in biology from CU Denver. Carla is a certified ecological restoration practitioner with the Society for

Ecological Restoration (SER) and a professional wetland scientist with the Society of Wetland Scientists. She is currently secretary on the board of the SER Rocky Mountain Chapter.

Virtual Garden Tour

Sunday, June 14; 1:00 - 2:00 PM

Be captivated as you visit Panayoti Kelaidis' private gardens, with a narrated visual tour. His garden reflects the many collection trips that he has taken, especially to the steppes of Central Asia with its semi-arid biomes characterized by extremes of cold and heat, dominated by forbs and grasses.

Panayoti Kelaidis is the senior curator and director of outreach for the Denver Botanic Gardens, and the Vice President of the North American Rock Garden Society. He also acts as a liaison to botanical societies, professional horticulture organizations and green industry members. Panayoti is the author of A Guide to Locating Rocky Mountain Wildflowers, and a co-author of Steppes: The Plants and Ecology of the World's Semi-arid Regions.

Colorado Plant Families

Saturday, June 20, 2020; 9:00 am – 12:00 pm

Presenter: Lenore Mitchell

Join us for a lively virtual exploration of Colorado's plant families. Extensive photos along with sketches of distinguishing characteristics will enhance identifying and keying flora. While there are approximately 155 plant families in Colorado, this presentation will emphasize those with the most species, for example Asteraceae (sunflowers) Brassicaceae (mustards) and Rosaceae (rose) along with common shrubs and some trees. This webinar is designed for beginners and intermediate amateur botanists or anyone new to our fabulous flora.

Lenore Mitchell is a native Coloradan who has taught basic botany courses in DU's Adult Ed Program for five years and CSU Extension's Native Plant Master Program for 14 years. She is also the current president of the Metro Chapter. Lenore has been a master gardener, a naturalist at Roxborough State Park, and a Denver Botanic Gardens hike leader for the alpenes at Mt Goliath.

Nature's Best Hope: A New Approach to Conservation that Starts in Your Yard

Thursday, July 16, 6:00-7:30 pm

Presenter: Doug Tallamy

An entomologist, behavioral ecologist, and professor at the University of Delaware, Doug will present a webinar based on his new book and New York Times Best Seller, *Nature's Best Hope: A New Approach to Conservation that Starts in Your Yard* (see page 24). He will highlight the effects that habitat loss and fragmentation have had on the landscape, and the result of the introduction of nonnative plant species. His suggestions include converting our yards into native plant corridors, installing motion detector porch lights to reduce moth declines, and much more. Doug will explain how we can reverse declining biodiversity and why we, ourselves, are nature's best hope. 🌀

In Memorium: Jack L. Carter

January 23, 1929—March 10, 2020

By Jennifer Boussetot

I can almost hear the biologist in Jack saying “I successfully completed my life cycle!” In fact, we discussed this very topic one summer day while I was weeding the newly established buffalograss slope at his and Martha’s place next to the High Line Canal south of downtown Denver. At first, I was shocked at his blunt assessment of life, but it also spoke to the scientist in me. Aren’t we all just trying to accomplish what we hope to before we complete our own life cycle? Isn’t that the true measure of our success on earth? Ah, and what a success life was for Jack.



Jack Carter in his early teaching years in Kansas.
@ Martha Carter

As an academic, I am in awe at what Jack has accomplished. The first and most important thing to the botanist in Jack was always his students, especially his Colorado College students. Not a single one of our weekly work days went by without Jack telling a story or two about his students at Simpson College, Emporia, University of Colorado, or Colorado College. Jack was a rare teacher. He wanted to get to know each of his students. He sincerely wanted them to complete his class or field trip with something that they *wanted* to learn. No wonder Colorado College named its herbarium after him!

Jack authored seven editions of three books: *Trees and Shrubs of Colorado* (two editions), *Trees and Shrubs of New Mexico* (two editions), and *Common Southwestern Native Plants* (three editions). The creative, yet painstaking, process for each and every

edition was fun for him. Jack thoroughly enjoyed collecting plants and writing exquisite descriptions of our western native plants. He would spend hours with his nose in botany books trying to gauge the appropriate elevation range or represent the most accurate distribution range. It was so refreshing to see Jack’s abiding pleasure on one important topic: our native flora. Don’t we all aspire to find and keep a passion for life? Jack was lucky enough to find it early on. In fact, his 90th birthday cake incorporated a saying from his late mother: “Laying in the Weeds for 90 Years!”

Every day of his life Jack wanted to learn new things and contribute to society. Each week, he would have a new book, article, or organization that he wanted to share with me and discuss. His heart was filled with CoNPS, the Native Plant Society of New Mexico (where he and Martha lived for 24 years after he retired from Colorado College), and the Audubon Society. Over the decades collecting plants for herbarium sheets, Jack fell in love with birding. Jack kept a tally of the species that visited his beloved feeder. Each year we updated his PowerPoint presentation to present to his friends and neighbors at the retirement village where he and Martha lived.

Jack has witnessed parts of 10 decades. Incredible. Born in the year of the great stock market crash and exited in the year of an historic pandemic. Logically, I knew that I would have to say farewell to Jack since 50 years were between us. But I still found myself hoping that he was immortal, especially as we hatched plans to write books and give talks. Jack and I met just five years ago. To some people that might seem too short, but Jack freely shared his wisdom and made every hour count.

No one else took the time that Jack did to advise me on all things academic, administrative, and environmental. Each week, I looked forward to our meeting so that I could hear his advice on the latest student situation, grant opportunity, or native plant conundrum. Our time together flew by each week.

Rarely do we humans find friends on such similar wavelengths. I am so very grateful that I was able to find a friend and mentor like Jack. Jack’s ethos and advice will live on in me as I mentor future generations of students on all things native plants.

Jennifer Boussetot is an assistant professor in the department of horticulture and landscape architecture at Colorado State University and the former marketing and events coordinator for CoNPS. Jen is a co-author of the CoNPS-published 3rd edition of Common Southwestern Native Plants.

Remembering William A. Weber

November 16, 1918—March 18, 2020

By Ron Wittmann



William A. Weber as a child in Bronx Park 1929/1930. Used with permission by the Weber Family Archive.

William A. Weber, world renowned botanist and eminent Colorado naturalist, passed away March 18. He was my mentor, colleague, and dear friend for almost 45 years. A complete account of our mutual history would occupy a sizeable volume. Here, I restrict myself to a few (mostly random) recollections.

I came to the University of Colorado in 1972 to do graduate work in

physics. I chose Colorado because the physics department was rated highly, but also because I'd been told that the state had a remarkable flora. Botany had been of great interest to me since I was a small child, and during my senior year at the University of Washington I studied plant taxonomy with C. Leo Hitchcock, the lead author of the five volume *Vascular Plants of the Pacific Northwest*. And yes, I'd heard of the legendary Dr. William A. Weber.

Among my first tasks on arrival was a visit to the University Bookstore to buy textbooks, but I also bought Harrington's *Manual of the Plants of Colorado* (1964) and, most importantly, Dr. Weber's *Rocky Mountain Flora*, 4th edition (1972). During the next several years, I completely wore out several copies of the *Flora* in my quest for plant knowledge, but I never had the courage to introduce myself to the august author. This changed in the spring of 1976 when I happened to meet the botanist Leo Simone. Leo was on sabbatical from SUNY, Potsdam. He told me that he had tea with Dr. Weber on Tuesday afternoons and asked if I would like to join them. I agreed with great excitement, but also with some trepidation. So, I went to tea at the appointed time—Dr. Weber was cordial, if a little gruff, and he showed no particular interest in me (which was not unexpected). Little did I realize the profound influence that this little meeting would exert on the following 44 years of my life.

Now that the ice was broken, I started bringing specimens to Dr. Weber. It was clear to me that I

needed to show that I could be useful in order to be admitted to the inner sanctum. One of the first things that I brought him was the prairie coneflower (*Echinacea angustifolia*), a taxon that previously had not been reported from Boulder County. He dropped everything, loaded me into his car, and together we drove to the collection locality. On another occasion, I brought my *Carex* (sedge) collection to the herbarium. As soon as I laid the specimens on the counter, Dr. Weber declared angrily, "Do you expect me to sit here and identify your collections for you?" "No," I said. "I've already made the ID's. With your permission, I'd like to check my determinations in the herbarium." With that exchange, Dr. Weber sat down and reviewed all twenty-five specimens with me! The lesson was this: If a person showed that he or she had made an effort, Dr. Weber had unlimited time to help; otherwise, not so much.

In 1973, Dr. Weber had published a treatise *Guide to the Mosses of Colorado* and I was very interested in learning something about bryophytes. One day I brought him a piece of a common moss (probably *Brachythecium erythrorrhizon*) hoping to start a conversation. "Don't waste my time with this," he said—end of discussion. I was disappointed. Mosses would have to wait...

At the beginning, our relationship was clearly Mentor and Apprentice. Field work was a good example. Initially, I spent most of my time following him on my hands and knees as he pointed out plants that I should collect. He never helped me with the press, even when the wind was howling and paper was flying. This went on for a seemingly long time, but then I noticed a change. He began helping with the collections and with managing the press. Even though I would always be his student, I was gradually transitioning to colleague. At some point he looked at me and said very sternly "Do not call me Dr. Weber! Call me Bill!" He said this so forcefully that I never dared call him anything but "Bill" after that. Well, except for the occasional, affectionate, "Herr Professor Doktor Weber" or just "Dr. Bill."

My real job as a physicist kept me busy on weekdays, so botanically I was a weekend warrior. Bill would stop by our apartment on Saturday mornings and we would walk to campus together often discussing the vegetation along the path. Part of the day was spent identifying plants, not just from Colorado, but from all around the world. Bill was meticulous about keeping up with the literature and as a result, we were constantly updating the floras and improving keys to make them more accurate and easier to use. Typically, the herbarium staff went to lunch together. Our retinue included

students and whomever happened to be visiting the herbarium. Regular participants included John Rohner, Curator of Museography, Ed Licht, the “Spider Man” (arachnologist), Miriam Colson (music teacher and expert on the genus *Carex*), and Jim Corbridge, Professor of Law and Chancellor University of Colorado Boulder. At the end of the day, we would typically leave the herbarium with a half dozen or more letters to be posted to various authorities. The environment was stimulating. There was so much to learn.

It could be said that Bill was extremely anti-technology. As an example, Bill absolutely detested “smart phones.” He hated to see young people with their faces glued to the screen, seemingly completely unaware of their surroundings. In my experience, however, Bill was an intelligent user of new paradigms. He just made sure that he was the master and that technology was the slave, not the other way around. Bill mocked me when I first started using a primitive GPS unit to record the locations of our collections, but it wasn’t long before he was the first to ask “What does the GPS say?” ...

... Perhaps Bill’s greatest legacy, as far as the general public is concerned, is found in his floras. The *Rocky Mountain Flora* (1953), originally published under the name *Handbook of Plants of the Colorado Front Range*, went through 5 editions. This was truly a beautiful creation, one that I had mostly memorized before I met the author. Bill never wished to write a comprehensive manual with full descriptions of the taxa; rather, he aimed for an inexpensive handbook that would fit into the day packs of interested amateurs. The coverage of the *Rocky Mountain Flora* was limited to the “front range” and surrounding regions. In the mid-1980’s Bill decided that he wanted to provide a comprehensive treatment for the entire state of Colorado. He could have written a state flora, but again, in the interests of smaller size and lower expense, he decided to produce 2 volumes. These became the *Colorado Flora: Western Slope* (1987) and the *Colorado Flora: Eastern Slope* (1990). Needless to say, this accomplishment required a monumental effort on his part. Subsequently, there was a revised (2nd) edition (1996) and a 3rd edition (2001). By the time the 3rd edition appeared, Bill was 83 years old. He had written in the preface that “...this is my final effort.” In my capacity as junior author, I deleted that sentence. With Jim Corbridge, Bill published a *Rocky Mountain Lichen Primer* (1998). A moss primer was in the works, but not completed.

The 4th edition of the *Colorado Flora* (2012) deserves special comment. After I retired in 2009, Bill and I met daily for 2 years to review the manuscript, genus by genus, in order to bring the taxonomy up to date and to account for new discoveries and insights. We also

added back the little stories that had been deleted over the years to save space. Several of our colleagues have commented that the floras were not only excellent technical volumes, but that they were also a good read. After the manuscripts were finished, Bill’s daughter, Linna, and I spent several months doing a thorough proof reading. Bill was very proud of this version and always said that it should be regarded as a new beginning, not just a 4th edition. He also said that “a flora is never complete.” Much remains to be done by those who follow.

Bill’s conversational style is worthy of mention. He had a very active and agile mind, and the subject of his discourse would often change radically without warning, sometimes mid-sentence. Even when he stayed on track, he left large holes that a listener would have to fill in in order to keep up. It was several years before I was able to follow him easily. The ability to speak fluent Weberese was sometimes very useful. For example in recent years, either he or I could often fill in a missing word or finish a phrase when the other was having a senior moment. I think that one reason Bill found computers so frustrating was that he never met a computer that could understand him. By the way, I never learned to read his handwriting, but that was OK. He couldn’t read it either.

At some point in the mid-1990’s, Bill told me that it was time I learned something about mosses. Bryophytes are subtle and difficult to master without expert help. I couldn’t have had a better mentor—Bill was especially patient with me. It took me such a long time to reliably recognize *Ceratodon*, a common weedy moss that can look like so many things. Mosses continued to be a major focus of our field activities for the remainder of our time together. By the time *Bryophytes of Colorado* was published in 2007, we could list over 500 species. This is to be compared to the 290 taxa that Bill reported in 1973. We never reached a point of diminishing returns. Almost every excursion yielded new records.

Through the years I was fortunate enough to spend literally thousands of hours doing field work with Bill in every county of the state. We frequently camped, with Bill sleeping in his vehicle and me lying out under the stars. In the mornings he would send out his little papillon, Suki, who would run to me, crawl in my sleeping bag, and lick my face. Bill liked to start early! We worked hard all day long and often into the evenings. In the field Bill was indefatigable, with boundless enthusiasm. To me he was a “kid in a candy store.” There was never a dull moment, but always something to be interested in or excited about. Paging through his books brings back many good memories. Alas, there is not enough space to give much of an accounting. For example, I remember a

day in Baca County when we found almost a dozen new plants for Colorado—and we had almost gone home early because of bad weather. On another occasion, we were standing in High Creek Fen talking about the probability of finding boreal bryophytes in our mountains. I bent over to examine a small fruiting moss. I said, “Bill, you’re not going to believe what I’m holding,” as I handed him a specimen of *Catoscopium nigrum*. The little “golf club moss” is perhaps not uncommon in the arctic but so far, we know only this one Colorado location. In later times, when rigorous field work was no longer possible, we would often walk through Boulder neighborhoods looking at what was growing in the gardens. When you were with Bill, even a weed lot could be a miraculous place. I well remember his excitement when he discovered the nondescript *Herniaria glabra* (rupturewort) in a waste space near his apartment.

In a time of specialization, when a botanist can spend a career studying a single family or even genus, Bill was unique. He knew the whole flora, not just the vascular plants, but he was equally knowledgeable of the lichens and bryophytes. Through extensive travel, he also knew the floras of many areas of the world. Bill is widely recognized for his groundbreaking efforts to catalog the lichen and bryophyte floras of the Galápagos Islands. ...

... Bill was not just a botanist, he was a man of eclectic tastes. He was a polyglot with a working knowledge of a half dozen languages in addition to botanical Latin. He was a voracious reader, an actor, an art collector, and a biographer. He was an accomplished birder (but that’s another story). He also enjoyed music and loved singing (tenor). ...

... For years we went to concerts together. I remember one occasion when we were returning from the field listening to Mahler’s Second Symphony. We drove at 20 mph so that we could finish the music before we got back to Boulder. Bill was very fond of Gilbert and Sullivan and would often sing arias to anyone who would listen. The last musical event we attended was a performance of the Takács Quartet on March 8, just ten days before his passing. Bill was uncharacteristically depressed because simple things were becoming so difficult, and mostly because he could no longer see to read. After the concert, however, he was effervescent especially due to a powerful performance of Beethoven’s wonderful Opus 131. Thank you, Takács! ...

... One day, I think Bill was about 85 at the time, we had wandered down into a steep ravine looking for a special bryophyte. The trip would have been difficult for the average person half his age, and I began to think that we had seriously over-extended ourselves. I was ahead. He was walking toward me, obviously

extremely exhausted and unsteady. Then suddenly, he fell to the ground. Fearing the worst, I rushed to his side—and found him on his stomach, intently examining a moss that had caught his interest. I would like to leave the reader with this picture, not of a frail old man, but of a perennially youthful, vibrant Bill Weber, lying in a meadow loupe in hand, marveling at the mysteries of nature.

Goodbye, Bill. We miss you.

Ron has been actively studying the native flora of Colorado since coming to the state in 1972. In 2002 he was awarded Honorary Life Membership by the Colorado Native Plant Society. These days, Ron maintains a one acre native plant garden that is rapidly becoming more than he can handle. He still pursues his botanical interests, but is also a consultant in the field of microwave antenna measurements.

We couldn’t fit the entirety of Ron’s heart-warming tribute to Dr. Weber in this issue, but you can read it all at conps.org. MM

Memoriam

By Arthur Clifford

Two trees stand in a wooded glen
Side by side hand in hand

In soft embrace no words are spoken
The perfect silence of morn' not broken

From fecund earth between them grows
The palest bloom from whitest rose

And not a thorn is found upon
The entwining vine.... that seals the bond



Limber pines (*Pinus flexilis*) on the Limber Pine Grove Trail southwest of Fairplay, CO.
© Kelly Ambler

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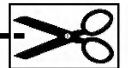
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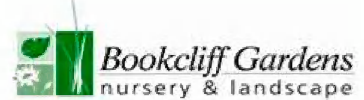
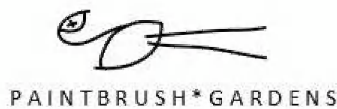
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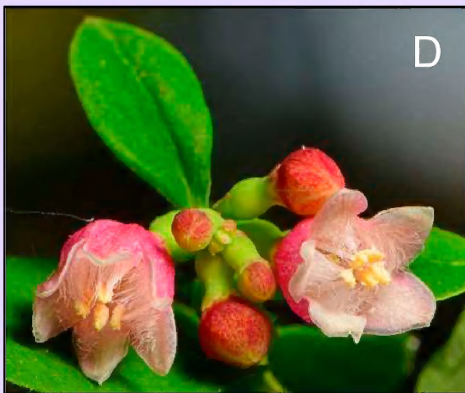
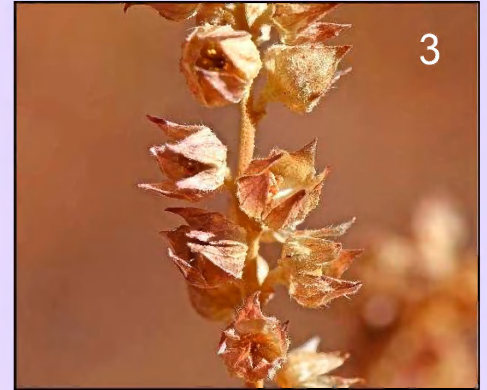
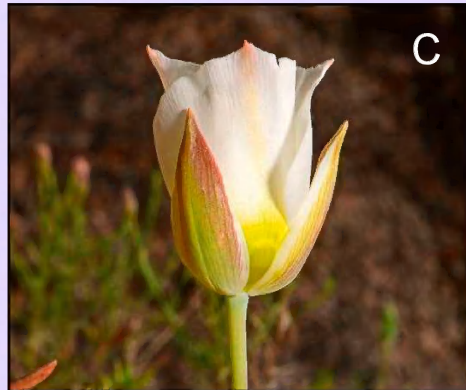
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Can You Match Flowers and Fruits?



Answers: A, 6 = Whipple's penstemon (*Penstemon whippleanus*, Plantaginaceae family); B, 4 = Stansbury's cliffrose (*Purshia stansburiana*, Rosaceae family); C, 5 = Nuttall's sego lily (*Calochortus nuttallii*, Liliaceae family); D, 1 = Roundleaf snowberry (*Symphoricarpos rotundifolius*, Caprifoliaceae family); E, 2 = fringed grass-of-Parnassus (*Parnassia fimbriata*, Parnassiaceae family); F, 3 = white checkerbloom (*Sidalcea candida*, Malvaceae family).



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Colorado Native Plant Society



P.O. Box 200
Fort Collins, Colorado 80522
<http://www.conps.org>

Please check the calendar of events on the CoNPS website regularly for chapter meetings, field trips, webinars, and more. With the evolving pandemic and safer-at-home measures, dates may change.

Mark Your Calendars 17th Rare Plant Symposium and 44th CoNPS Annual Conference September 18 and 19 on the Front Range in 2020

The conference planning committee is planning a great event. This year's theme is: **"Peaks to Prairies—Plants in a Land of Extremes."** Presenters at the conference include the following people.

Jennifer Ackerfield, Head curator of Natural History Collections and associate director of biodiversity research, Denver Botanic Gardens, **"Thistle Be Fun: New Species Discoveries"**

Jennifer Bousselot, Assistant professor, department of horticulture and landscape architecture, Colorado State University, **"Colorado Native Plant Availability in The Green Industry"**

Beth Hanson, Park interpreter, South Platte Park, South Suburban Parks and Recreation District, **"Audience Participation: Smartphone-Based, Plant-Trivia Game"**

Mike Kintgen, Curator, alpine collections, Denver Botanic Gardens, **"Circumboreal Alpines & Biogeography"**

Shannon Murphy, Associate professor, department of biological sciences, University of Denver, **"Light**

Pollution Affects Invasive and Native Plant Traits Important to Plant Competition and Herbivorous Insects"

Tim Seastedt, Professor, department of ecology and evolutionary biology, University of Colorado at Boulder, **"Climate Change Effects on Herbaceous Plant Community Composition in the Colorado Front Range"**

Heidi Steltzer, Professor, departments of environment & sustainability and biology, Fort Lewis College, **"The Richness of Plants in the Mountains Benefits People"**

Steve Yarbrough, Certified ecologist and professional wetland scientist, Tetra Tech, Inc., **"Fen Ecosystems of Colorado"**

Presenters, topics, and specific presentation titles may change between now and August. The Summer issue of *Aquilegia* will contain full details for registering for this event. The in-person conference will be replaced with webinars, if necessary.